MAINTENANCE MANUAL

TURBOFAN ENGINE

Model(s)

JT15D-5 and JT15D-5R

Manual Part No. 3033442

12 August 1983

The contents of this manual have been examined and found acceptable to the Minister in meeting the requirements of an Engine Maintenance Manual for the Pratt & Whitney Canada JT15D-5 and JT15D-5R engines, as required by the Canadian Airworthiness Manual, Chapter 533.4 “Instructions for Continued Airworthiness”.

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PRATT & WHITNEY CANADA
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Apr 04/2016

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Pratt & Whitney Canada
A United Technologies Company

April 11, 2016

REVISION TRANSMITTAL SHEET

TO: Holders of the Pratt & Whitney Canada Maintenance Manual for JT15D-5/5R Engines, Manual Part No. 3033442.

SUBJECT: Revision No. 41, dated Apr 04/2016

Please insert the attached Revision No. 41 pages into your copy of the JT15D-5/5R Maintenance Manual. Remove and destroy superseded pages.

Extreme care should be exercised in updating your copy of the manual. To ensure that you do not inadvertently discard pages that should be retained, the manual should be updated in accordance with the Lists of Effective Pages.

Pages supplied with the new date and revision bars but no visible change may contain coding changes transparent to the user and should be inserted as part of the revision.

Please add Revision No. 41 to the Record of Revisions.

Any discrepancies, problems or suggestions regarding this revision should be forwarded in writing using the Pratt & Whitney Canada Customer Feedback Sheet (RSVP), and directed to:

Pratt & Whitney Canada Corp.
1000 Marie-Victorin
Longueuil, Québec
Canada J4G 1A1

Attention: Manager, Technical Publications (05MS1)
Email: customer.service@pwc.ca
Fax: (450) 468-7688

Customer Feedback Sheets are contained with new manuals and each subsequent revision. You may also submit your feedback via our on-line RSVP form available at:
www.pwc.ca/en/3_0/3_0_6/3_0_6_5_7.asp.

JT15D-5/5R MAINTENANCE MANUAL
REVISION NO. 41 HIGHLIGHTS

CH/SE/SU	Description of Change
Title Page	The title page has been revised to update the export controls classification table.
Service Bulletin List	Service Bulletin list has been updated to revise SB7288R3 to SB7288R4.
	Service Bulletin list has been updated to revise SB7001R24 to SB7001R26.
	Service Bulletin list has been updated to revise SB7244R3 to SB7244R5.
	Service Bulletin list has been updated to revise SB7526R1 to SB7526R3.
	Service Bulletin list has been updated to revise SB7493R3 to SB7493R5.
	Service Bulletin list has been updated to revise SB7003R35 to SB7003R38.
	Service Bulletin list has been updated to add SB7628R2.
Introduction	Customer Support
	Editorial correction has been done.
	Abbreviations
	The abbreviation list has been updated to add lbf.in.
Special Tools, Fixtures and Equipment	Ordering Special Tools
	The accredited supplier address and PWC tooling services have been replaced by SIL GEN-022 for the purchase of special tools.
71-00-00 Testing	Engine Operating Limits
	The note has been revised to add oil pressure value 150 psig (1034 Kpa gauge) under cold starting condition in the engine operating limits table.
72-00-00 Servicing	Storage and Shipping
	The reference to the removal and installation procedure of the remote oil indicator panel has been added in the removal procedure of the engine from the shipping container.
	Regular Operation as an Alternative to the Preservation of Engines
	Editorial change made to formatting non-technical content.
72-00-00 Inspection	Fixtures-and-equipment
	The fixtures, equipment and supplier tools list has been revised to modify a 5 mm or less borescope.
	Borescope Inspection

JT15D-5/5R MAINTENANCE MANUAL
REVISION NO. 41 HIGHLIGHTS

CH/SE/SU	Description of Change
	The procedure of LP compressor boost stage rotor and front inner stator has been revised to replaced word fiberscope with boroscope.
72-60-02 Maintenance Practices	Removal/Installation The references to the applicable components to be removedinstalled have been added in the removalinstallation procedures of the accessory drive seals.
73-20-04 Maintenance Practices	Installation of Engine Wiring Harness Editorial correction, callout for P6 connector corrected: was (18).
77-00-01 Maintenance Practices	Removal/Installation Editorial correction, callouts corrected in clamping steps and nomenclature in figure key.

RECORD OF REVISIONS

REV NO.	ISSUE DATE	DATE INSERTED	BY
1	Apr 19/85		P&WC
2	Nov 28/85		P&WC
3	Aug 20/86		P&WC
4	Mar 27/87		P&WC
5	Mar 27/88		P&WC
6	Jan 15/90		P&WC
7	Nov 01/90		P&WC
8	Jul 01/91		P&WC
9	Feb 01/92		P&WC
10	Aug 01/92		P&WC
11	Feb 01/93		P&WC
12	Sep 01/93		P&WC
13	Jun 01/94		P&WC
14	Mar 01/95		P&WC
15	Mar 14/97		P&WC
16	Jun 06/97		P&WC
17	Sep 05/97		P&WC
18	Jan 23/98		P&WC
19	May 15/98		P&WC
20	Sep 21/98		P&WC
21	Jun 25/99		P&WC
22	Oct 22/99		P&WC
23	Sep 29/2000		P&WC
24	Apr 13/2001		P&WC
25	Sep 28/2001		P&WC
26	Apr 18/2002		P&WC
27	Jul 05/2002		P&WC
28	Nov 01/2002		P&WC
29	Oct 31/2003		P&WC

REV NO.	ISSUE DATE	DATE INSERTED	BY
30	Sep 03/2004		P&WC
31	Dec 09/2004		P&WC
32	Oct 06/2006		P&WC
33	Mar 09/2007		P&WC
34	Aug 08/2008		P&WC
35	Nov 07/2008		P&WC
36	Jan 09/2009		P&WC
37	Feb 18/2011		P&WC
38	May 13/2013		P&WC
39	Feb 03/2014		P&WC
40	Nov 10/2014		P&WC
41	Apr 04/2016	APR 25, 2016	ATP/RLL

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RECORD OF TEMPORARY REVISIONS

TR. NO.	CH/SE/SU	PAGE NO.	ISSUE DATE	INSERTED BY	DATE REMOVED	REMOVED BY
73-3	73-10-05	207	DEC 7, 2016	ATP/RLL		

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
Title Page		Apr 04/2016
Record of Revisions		Aug 12/83
Record of Temporary Revisions		Aug 12/83
LEP	1	Apr 04/2016
	2 blank	Apr 04/2016
List of Chapter/ Section/Subjects	1	Aug 08/2008
	2	Aug 08/2008
	3	Aug 08/2008
	4	Aug 08/2008
Temporary Revision Index	1	May 13/2013
	2 blank	May 13/2013
Service Bulletin List	1	Apr 04/2016
	2	Apr 04/2016
	3	Apr 04/2016
	4	Apr 04/2016
	5	Apr 04/2016
	6	Apr 04/2016

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LIST OF CHAPTER/SECTION/SUBJECTS

CHAPTER/SECTION/SUBJECT	TITLE
INTRODUCTION	Introduction
AIRWORTHINESS LIMITATIONS	Airworthiness Limitations
70-00	Standard Practices
70-00-00	Standard Practices
71-00	Power Plant
71-00-00	Power Plant
72-00	Engine: Turbine
72-00-00	Engine
72-30	Compressor Section
72-30-00	Compressor Section
72-30-01	LP Compressor Case and Stators
72-30-02	Intermediate Case Assembly
72-30-03	LP Compressor Rotor Assemblies
72-30-04	No.1 Bearing and N1 Speed Sensing
72-30-05	Gas Generator Case
72-30-06	High Pressure Compressor Assembly
72-30-07	LP Compressor Bleed Air System
72-40	Combustion Section
72-40-00	Combustion Section
72-40-01	Combustion Chamber, LP Turbine Stator Support
72-50	Turbine Section
72-50-00	Turbine Section
72-50-01	HPT Stator, Exit Ducts
72-50-02	HP Turbine Disk Balancing Assembly
72-50-03	LP Turbine Rotor Balancing Assembly
72-50-04	Second Stage LP Turbine Stator

CHAPTER/SECTION/SUBJECT	TITLE
72-50-05	Third Stage LP Turbine Stator
72-50-06	Exhaust Duct Assembly
72-60	Accessory Gearbox
72-60-00	Accessory Drives
72-60-01	Accessory Gearbox and Driveshaft
72-60-02	AGB Externals and Oil Pump
72-70	Bypass Section
72-70-00	Bypass Section
72-70-01	Front Inner Bypass Duct Assembly
72-70-02	Rear Inner Bypass Duct Assembly
72-70-03	Outer Bypass Duct Assembly
72-70-04	Engine Rear Mount
73-00	Engine Fuel and Control
73-00-00	Engine Fuel and Control
73-10	Fuel Distribution
73-10-01	Fuel-to-Oil Cooler and Fuel Tubes
73-10-02	Fuel Pump
73-10-03	Fuel Tubes, FDV to Fuel Manifold
73-10-04	Flow Divider Valve
73-10-05	Fuel Manifold Assembly
73-10-06	Fuel Drain Valve
73-10-07	Fuel Flowmeter Installation
73-10-09	Fuel Pressure and Bypass Tubes
73-10-10	HP Compressor Air Delivery Tubes
73-10-11	Emergency Fuel Shut-off System
73-10-12	Bleed Valve Actuator
73-10-13	Fuel Filter And Impending Bypass Switch

CHAPTER/SECTION/SUBJECT	TITLE
73-10-14	Fuel/Oil Heat Exchanger (JT15D-5R)
73-20	Fuel Control
73-20-02	Hydromechanical Metering Unit
73-20-03	Engine Electronic Control
73-20-04	Engine Electrical Wiring Harness
73-20-05	Speed and Temperature Sensors
74-00	Ignition
74-00-00	Ignition
74-10	Ignition
74-10-01	Ignition Exciter
74-20	Ignition
74-20-01	Ignition Exciter Cables
74-20-02	Spark Igniters
75-00	Air
75-00-00	Air Systems
75-00-01	T1 Thermocouple Anti-icing Air Tube
75-00-02	Anti-icing Solenoid Valve
75-00-03	Cabin Air Bleed
77-00	Engine Indicating
77-00-00	ITT Sensing System
77-00-01	T1 Thermocouple Wiring Harness
77-00-02	T6 Wiring Harness and Probes
79-00	Oil
79-00-00	Oil System
79-00-01	Oil System
79-20	Oil Distribution (JT15D-5)
79-20-00	Distribution (JT15D-5)

CHAPTER/SECTION/SUBJECT	TITLE
79-20-01	Oil Filter Housing (JT15D-5)
79-20-02	Check Valves and Tubes (JT15D-5)
79-20-03	External Pressure Oil Tubes (JT15D-5)
79-20-04	External Scavenge Oil Tubes (JT15D-5)
79-21	Oil Distribution (JT15D-5R)
79-21-00	Distribution (JT15D-5R)
79-21-01	Oil Filter Housing (JT15D-5R)
79-21-02	Check Valves and Tubes (JT15D-5R)
79-21-03	External Pressure Oil Tubes (JT15D-5R)
79-21-04	External Scavenge Oil Tubes (JT15D-5R)
79-30	Oil Indicating
79-30-00	Oil Indicating
79-30-01	Oil Filler-Neck and Oil Filler Cap
79-30-02	R/O/L Indicator Panel
79-30-03	R/O/L Indicator and Housing
79-30-04	R/O/L Indicator Vent Tubes
79-30-05	Chip Detection System

TEMPORARY REVISION LIST

T.R. No.	Filed Adjacent to	T.R. Status
A/L-1	Airworthiness, Page 1, Airworthiness Limitations	Incorporated at Rev. No. 21
71-1 thru 71-5		Incorporated at a previous revision
71-6	71-02-50, Page 533 Power Plant - Adjustment/Test	Incorporated at Rev. No. 15
71-7	71-02-50, Page 534 Power Plant - Adjustment/Test	Incorporated at Rev. No. 15
72-1 thru 72-25		Incorporated at a previous revision
72-26	72-52-56, Page 212 Engine - Maintenance Practices	Incorporated at Rev. No. 15
72-27	72-52-51, Page 219 Engine - Maintenance Practices	Incorporated at Rev. No. 15
72-28	72-50-01, Page 219 HPT Stator, Exit Ducts - Maintenance Practices	Incorporated at Rev. No. 19
72-29	72-00-00, Page 106 Fault Isolation	Incorporated at Rev. No. 26
72-30	72-00-00, Page 602 Engine: Turbine - Inspection	Incorporated at Rev. No. 29
72-31	72-00-00, Page 627 Engine: Turbine - Inspection	Incorporated at Rev. No. 29
72-32	72-00-00, Page 621 Engine: Turbine - Inspection	Incorporated at Rev. No. 30
72-33	72-00-00, Page 103 Engine: Turbine - Fault Isolation	Incorporated at Rev. No. 33
72-34		Never Issued
72-35		Never Issued
72-36	72-00-00, Page 615 Engine: Turbine - Inspection	Incorporated at Rev. No. 37
72-37	72-00-00, Page 616 Engine: Turbine - Inspection	Incorporated at Rev. No. 38
73-1		Incorporated at a previous revision
73-2	73-12-51, Page 205 Engine Fuel and Control - Maintenance Practices	Incorporated at Rev. No. 15
74-1 thru 74-5		Incorporated at a previous revision
79-1		Incorporated at a previous revision

All succeeding Temporary Revisions must be retained in your printed manual until directed otherwise by subsequent revision activity.

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SERVICE BULLETIN LIST

This list identifies all Service Bulletins (SB's) for the engine model. Bulletins considered to have no effect on manual have the words "No Effect" added; incorporated bulletins have their date of incorporation indicated.

The incorporation of Service Bulletins on each engine is recorded in the engine log book and related documents.

For a current set of all JT15D Series Engine Service Bulletins (Engine Model Group 04), use ordering number 3026524. For a current set of JT15D-5 engine Service Bulletins, use ordering number 3033445.

NOTE: Engine Service Bulletins with 'See NOTE' in the Effect/Date Incorporated column are being continually revised to reflect P&WC recommendations for engine lubricating oils, engine fuels, engine planned maintenance, etc., and are concurrent with incorporation of engine modifications.

P&WC SB No.	ATA SB No.	Rev. No.	Engine Model Applicability	Effect/Date Incorporated
7001	72-7001	26	JT15D-5/-5R	See NOTE
7002	72-7002	42	JT15D-5/-5R	See NOTE
7003	72-7003	38	JT15D-5/-5R	See NOTE
7144	72-7144	19	JT15D-5	See NOTE
7150	72-7150	7	JT15D-5	No Effect
7206	72-7206	2	JT15D-5	No Effect
7207	72-7207	1	JT15D-5	Mar 27/87
7209	72-7209	1	JT15D-5	No Effect
7210	72-7210	1	JT15D-5	Apr 19/85
7211	72-7211	Orig.	JT15D-5	Nov 28/85
7212	72-7212	Orig.	Superseded by SB7329	No Effect
7213	72-7213	Orig.	JT15D-5	No Effect
7218	72-7218	1	JT15D-5	No Effect
7219	72-7219	Orig.	JT15D-5	No Effect
7220	72-7220	3	JT15D-5	Nov 28/85
7222	72-7222	Orig.	JT15D-5	Aug 20/86
7223	72-7223	Orig.	JT15D-5	Aug 20/86
7227	72-7227	Orig.	JT15D-5	No Effect
7229	72-7229	1	JT15D-5	No Effect
7230	72-7230	1	JT15D-5	No Effect
7231	72-7231	2	JT15D-5	No Effect
7234	72-7234	Orig.	JT15D-5	Aug 20/86
7235	72-7235	1	JT15D-5	Mar 27/87
7237	72-7237	Orig.	JT15D-5	No Effect
7243	72-7243	Orig.	JT15D-5	No Effect
7244	72-7244	5	JT15D-5	No Effect
7245	72-7245	1	JT15D-5	Mar 27/87
7246	72-7246	8	JT15D-5	No Effect

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P&WC SB No.	ATA SB No.	Rev. No.	Engine Model Applicability	Effect/Date Incorporated
7247	72-7247	1	JT15D-5	No Effect
7248	72-7248	1	JT15D-5	Mar 27/87
7249	72-7249	Orig.	JT15D-5	No Effect
7250	72-7250	3	JT15D-5	Mar 27/87
7252	72-7252	1	JT15D-5	No Effect
7258	72-7258	1	JT15D-5	No Effect
7260	72-7260	1	JT15D-5	Mar 01/95
7264	72-7264	2	JT15D-5	Feb 01/93
7266	72-7266	Orig.	JT15D-5	No Effect
7269	72-7269	3	JT15D-5	No Effect
7273	72-7273	1	JT15D-5	Nov 01/90
7280	72-7280	1	JT15D-5	Feb 01/93
7281	72-7281	Orig.	Superseded by SB7306	Jan 15/90
7282	72-7282	1	JT15D-5	No Effect
7286	72-7286	2	JT15D-5	No Effect
7287	72-7287	Orig.	Superseded by SB7327	No Effect
7288	72-7288	4	JT15D-5	No Effect
7289	72-7289	Orig.	Superseded by SB7309	No Effect
7290	72-7290	Orig.	JT15D-5	No Effect
7291	72-7291	3	JT15D-5	Nov 01/90
7292	72-7292	Orig.	JT15D-5	Feb 01/92
7294	72-7294	1	JT15D-5	No Effect
7295	72-7295	2	JT15D-5	Feb 01/93
7297	72-7297	1	JT15D-5	Jun 01/94
7298	72-7298	1	JT15D-5	Feb 01/92
7299	72-7299	Orig.	JT15D-5	No Effect
7301	72-7301	2	JT15D-5	No Effect
7304	72-7304	Orig.	JT15D-5	No Effect
7305	72-7305	Orig.	JT15D-5	Feb 01/93
7306	72-7306	Orig.	JT15D-5	Feb 01/92
7308	72-7308	1	JT15D-5	Jul 01/91
7309	72-7309	2	JT15D-5	Feb 01/92
7315	72-7315	1	JT15D-5	No Effect
7317	72-7317	2	JT15D-5	Jun 01/94
7318	72-7318	1	JT15D-5	Jun 01/94
7319	72-7319	Orig.	JT15D-5	Aug 01/92
7321	72-7321	1	JT15D-5	No Effect
7322	72-7322	Orig.	JT15D-5	Aug 01/92
7323	72-7323	1	JT15D-5	Aug 01/92
7324	72-7324	3	JT15D-5	Aug 01/92
7325	72-7325	1	JT15D-5	No Effect
7326	72-7326	Orig.	JT15D-5	No Effect
7327	72-7327	1	JT15D-5	No Effect
7328	72-7328	1	JT15D-5	No Effect

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P&WC SB No.	ATA SB No.	Rev. No.	Engine Model Applicability	Effect/Date Incorporated
7329	72-7329	2	JT15D-5	Aug 01/92
7330	72-7330	2	JT15D-5	No Effect
7335	72-7335	Orig.	JT15D-5	Feb 01/93
7337	72-7337	5	JT15D-5	No Effect
7338	72-7338	Orig.	JT15D-5	No Effect
7339	72-7339	Orig.	JT15D-5	No Effect
7340	72-7340	2	JT15D-5	No Effect
7341	72-7341	1	JT15D-5	No Effect
7344	72-7344	1	JT15D-5	No Effect
7345	72-7345	Orig.	JT15D-5	Feb 01/93
7350	72-7350	2	JT15D-5	No Effect
7351	72-7351	1	JT15D-5	No Effect
7352	72-7352	1	JT15D-5	Feb 01/93
7354	72-7354	1	JT15D-5	No Effect
7355	72-7355	2	JT15D-5	No Effect
7356	72-7356	Orig.	JT15D-5	No Effect
7357	72-7357	Orig.	JT15D-5	Feb 01/93
7359	72-7359	Orig.	JT15D-5	No Effect
7360	72-7360	Orig.	JT15D-5	Feb 01/93
7361	72-7361	Orig.	JT15D-5	No Effect
7362	72-7362	2	JT15D-5	Jun 01/94
7363	72-7363	1	JT15D-5	No Effect
7366	72-7366	Orig.	JT15D-5	Jun 01/94
7367	72-7367	1	JT15D-5	No Effect
7368	72-7368	2	JT15D-5	No Effect
7369	72-7369	2	JT15D-5	Feb 18/2011
7375	72-7375	2	JT15D-5	No Effect
7377	72-7377	1	JT15D-5	No Effect
7378	72-7378	1	JT15D-5	No Effect
7379	72-7379	1	JT15D-5	No Effect
7384	72-7384	5	JT15D-5	Feb 18/2011
7385	72-7385	3	JT15D-5	No Effect
7389	72-7389	3	JT15D-5	Jun 01/94
7391	72-7391	1	JT15D-5	Mar 14/97
7392	72-7392	1	JT15D-5	No Effect
7394	72-7394	2	JT15D-5	No Effect
7396	72-7396	Orig.	JT15D-5	No Effect
7399	72-7399	2	JT15D-5	Sep 01/93
7406	72-7406	Orig.	JT15D-5	No Effect
7407	72-7407	1	JT15D-5	No Effect
7408	72-7408	Orig.	JT15D-5	No Effect
7409	72-7409	Orig.	JT15D-5	No Effect
7410	72-7410	2	JT15D-5	Jun 01/94
7411	72-7411	2	JT15D-5	No Effect

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P&WC SB No.	ATA SB No.	Rev. No.	Engine Model Applicability	Effect/Date Incorporated
7412	72-7412	Orig.	JT15D-5	Mar 01/95
7413	72-7413	2	JT15D-5	No Effect
7415	72-7415	1	JT15D-5	Jul 05/2002
7419	72-7419	Orig.	JT15D-5	No Effect
7425	72-7425	Orig.	JT15D-5	Jun 01/97
7426	72-7426	1	JT15D-5	Jun 01/94
7428	72-7428	1	JT15D-5	No Effect
7429	72-7429	4	JT15D-5	No Effect
7432	72-7432	Orig.	JT15D-5	Mar 01/95
7433	72-7433	Orig.	JT15D-5	Mar 01/95
7436	72-7436	Orig.	JT15D-5	Mar 01/95
7437	72-7437	2	JT15D-5	No Effect
7438	72-7438	2	JT15D-5	No Effect
7440	72-7440	Orig.	JT15D-5	No Effect
7442	72-7442	Orig.	JT15D-5	No Effect
7444	72-7444	Orig.	JT15D-5	No Effect
7447	72-7447	Orig.	JT15D-5	No Effect
7450	72-7450	Orig.	JT15D-5	No Effect
7452	72-7452	4	JT15D-5	No Effect
7457	72-7457	1	JT15D-5	No Effect
7459	72-7459	2	JT15D-5	No Effect
7461	72-7461	Orig.	JT15D-5	Mar 01/95
7465	72-7465	Orig.	JT15D-5	No Effect
7471	72-7471	3	JT15D-5	No Effect
7472	72-7472	2	JT15D-5	Jun 06/97
7476	72-7476	1	JT15D-5	Apr 18/2002
7483	72-7483	2	JT15D-5	No Effect
7484	72-7484	6	JT15D-5	No Effect
7488	72-7488	1	JT15D-5	No Effect
7490	72-7490	1	JT15D-5	No Effect
7493	72-7493	5	Superseded by SB7526	No Effect
7499	72-7499	5	JT15D-5	No Effect
7500	72-7500	1	JT15D-5	No Effect
7501	72-7501	Orig.	JT15D-5	Sep 05/97
7503	72-7503	1	JT15D-5	No Effect
7511	72-7511	1	JT15D-5	No Effect
7513	72-7513	4	JT15D-5	No Effect
7515	72-7515	3	JT15D-5	No Effect
7521	72-7521	2	JT15D-5	No Effect
7525	72-7525	1	JT15D-5	No Effect
7526	72-7526	3	JT15D-5	No Effect
7528	72-7528	Orig.	JT15D-5	No Effect
7529	72-7529	Orig.	JT15D-5	No Effect
7530	72-7530	1	JT15D-5	Apr 13/2001

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

P&WC SB No.	ATA SB No.	Rev. No.	Engine Model Applicability	Effect/Date Incorporated
7531	72-7531	1	JT15D-5	No Effect
7532	72-7532	Orig.	JT15D-5	No Effect
7535	72-7535	Orig.	JT15D-5	No Effect
7537	72-7537	2	JT15D-5	No Effect
7540	72-7540	Orig.	JT15D-5	No Effect
7541	72-7541	Orig.	JT15D-5	No Effect
7542	72-7542	1	JT15D-5	No Effect
7545	72-7545	2	JT15D-5	No Effect
7547	72-7547	1	JT15D-5	No Effect
7549	72-7549	1	JT15D-5	No Effect
7550	72-7550	Orig.	JT15D-5	Sep 28/2001
7556	72-7556	1	Superseded by SB7559	No Effect
7557	72-7557	Orig.	JT15D-5	No Effect
7559	72-7559	Orig.	JT15D-5	No Effect
7562	72-7562	5	Superseded by SB7568	No Effect
7564	72-7564	Orig.	JT15D-5	No Effect
7565	72-7565	Orig.	JT15D-5	No Effect
7568	72-7568	1	JT15D-5	Feb 18/2011
7571	72-7571	2	JT15D-5	No Effect
7572	72-7572	Orig.	JT15D-5	No Effect
7576	72-7576	Orig.	JT15D-5	No Effect
7580	72-7580	2	JT15D-5	Superseded by SB7586
7581	72-7581	Orig.	JT15D-5	Jul 05/2002
7586	72-7586	Orig.	JT15D-5	No Effect
7588	72-7588	1	JT15D-5	No Effect
7589	72-7589	1	JT15D-5	No Effect
7593	72-7593	1	JT15D-5	Feb 18/2011
7596	72-7596	1	JT15D-5	Dec 09/2004
7597	72-7597	1	JT15D-5	Dec 09/2004
7598	72-7598	Orig.	JT15D-5	Sep 03/2004
7599	72-7599	Orig.	JT15D-5	Sep 03/2004
7600	72-7600	Orig.	JT15D-5	Sep 03/2004
7602	72-7602	Orig.	JT15D-5	No Effect
7605	72-7605	2	JT15D-5	No Effect
7608	72-7608	Orig.	JT15D-5R	Oct 06/2006
7609	72-7609	1	JT15D-5/-5R	No Effect
7621	72-7621	Orig.	JT15D-5/-5R	No Effect
7622	72-7622	1	JT15D-5/-5R	Feb 18/2011
7625	72-7625	1	JT15D-5/-5R	No Effect
7626	72-7626	Orig.	JT15D-5R	No Effect
7627	72-7627	Orig.	JT15D-5	No Effect
7628	72-7625	2	JT15D-5/-5R	No Effect
7629	72-7629	Orig.	JT15D-5	No Effect

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P&WC SB No.	ATA SB No.	Rev. No.	Engine Model Applicability	Effect/Date Incorporated
7630	72-7630	Orig.	JT15D-5/-5R	No Effect
7634	72-7634	Orig.	JT15D-5	No Effect

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The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT PAGE

TITLE PAGE

REVISION HIGHLIGHTS

RECORD OF REVISIONS

RECORD OF TEMPORARY REVISIONS

LIST OF CHAPTER/SECTION/SUBJECTS

TEMPORARY REVISION LIST

SERVICE BULLETIN LIST

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
LEP	1	Apr 04/2016
	2	Apr 04/2016
Contents	1	Apr 04/2016
	2	Apr 04/2016
Introduction	1	Apr 04/2016
	2	Apr 04/2016
	3	Apr 04/2016
	4	Apr 04/2016
	5	Apr 04/2016
	6	Apr 04/2016
Special Tools Fixtures and Equipment	1	Apr 04/2016
	2	Apr 04/2016
	3	Apr 04/2016
	4	Apr 04/2016
	5	Apr 04/2016
	6	Apr 04/2016
	7	Apr 04/2016
	8	Apr 04/2016
	9	Apr 04/2016
	10	Apr 04/2016
	11	Apr 04/2016
	12	Apr 04/2016
	13	Apr 04/2016
	14	Apr 04/2016
	15	Apr 04/2016
	16	Apr 04/2016
	17	Apr 04/2016
	18	Apr 04/2016
	19	Apr 04/2016
	20	Apr 04/2016
	21	Apr 04/2016
	22	Apr 04/2016
	23	Apr 04/2016
	24	Apr 04/2016
	25	Apr 04/2016
	26	Apr 04/2016
	27	Apr 04/2016
	28	Apr 04/2016
	29	Apr 04/2016
	30	Apr 04/2016
	31	Apr 04/2016
	32	Apr 04/2016
	33	Apr 04/2016
	34	Apr 04/2016
	35	Apr 04/2016
	36	Apr 04/2016
	37	Apr 04/2016
	38 blank	Apr 04/2016
Consumable Materials	1	May 13/2013
	2	May 13/2013
	3	May 13/2013
	4	May 13/2013
	5	May 13/2013
	6	May 13/2013
	7	May 13/2013
	8	May 13/2013
	9	May 13/2013
	10	May 13/2013
	11	May 13/2013
	12	May 13/2013
	13	May 13/2013
	14	May 13/2013
	15	May 13/2013
	16	May 13/2013
	17	May 13/2013
	18	May 13/2013
	19	May 13/2013
	20	May 13/2013
	21	May 13/2013
	22	May 13/2013
	23	May 13/2013
	24	May 13/2013
	25	May 13/2013
	26	May 13/2013
	27	May 13/2013
	28	May 13/2013
	29	May 13/2013
	30	May 13/2013

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
INTRODUCTION	
1. General	1
2. Customer Support	1
3. Maintenance Concept	2
A. Line Maintenance	2
B. Heavy Maintenance	2
4. Supplementary Publications	2
5. Service Bulletins	2
6. Special Tool Service Bulletins	2
7. Suppliers and Supplier Services	3
8. Build Specification (BS)	3
9. How to Use this Manual	3
A. Chapter/Section/Subject Numbering	3
10. Engine Part Nomenclature	4
11. Directional References	4
12. Abbreviations	4
SPECIAL TOOLS/FIXTURES AND EQUIPMENT	
1. Special Tools	1
A. General	1
B. Ordering Special Tools	1
2. Special Tools	1
3. Torque Wrench	24
A. General	24
B. Torque Wrench PWC31050	24
C. PWC31050 Operation	24
D. Torque Wrench PWC41050	25

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT PAGE

SPECIAL TOOLS/FIXTURES AND EQUIPMENT (Cont'd)

4. Supplementary Tool Information 25

5. Special Fixtures and Equipment 32

CONSUMABLE MATERIALS

1. Consumable Materials 1

   A. General 1

   B. Consumable Material Table 1

2. Consumable Materials 3

   A. Supplier Codes 3

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

INTRODUCTION

1. General

A. This maintenance manual contains the recommended procedures for maintaining JT15D engines manufactured by Pratt & Whitney Canada. Personnel involved with engine maintenance should acquaint themselves with the contents of the following introductory paragraphs for full comprehension of the information contained in this manual.

B. Procedures in this manual may be accomplished with the engine installed or removed from the airframe. This manual will be revised as necessary to incorporate any changes as they arise and also incorporate latest approved procedures and data. This manual is not customized to any particular airframe installation. Configurational variations that may arise as a result of installation or peculiar requirement will be dealt with in the text as they occur.

C. Any discrepancies, problems or suggestions regarding this publication should be forwarded, using the Pratt & Whitney Canada Customer Feedback Sheet (RSVP), and directed to:

Pratt & Whitney Canada Corp.
1000 Marie-Victorin Blvd.
Longueuil, Quebec
Canada J4G 1A1

Attention: Manager, Publications Dept. (05MS1)
TEL: Website: www.pwc.ca
FAX: (450) 468-7688
E-mail: customer.service@pwc.ca

NOTE: 1. A new on-line RSVP form is available via the P&WC website at (http://www.pwc.ca)

NOTE: 2. Customer Feedback Sheets are enclosed with new manuals and each subsequent revision. Additional forms may be obtained by contacting: The Supervisor, Publications Customer Services Dept., at the above address.

2. Customer Support

A. Customer Service representatives maintain contact with operators and service activities and are available for investigation of any specific difficulty or problem. Request for assistance should be directed to:

Pratt & Whitney Canada Corp.
1000 Marie-Victorin Blvd.
Longueuil, Quebec
Canada J4G 1A1

Attention: Customer Service (01PM4)

B. Request for AOG support should also be directed to:

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Pratt & Whitney Canada Corp.
1000 Marie-Victorin Blvd.
Longueuil, Quebec
Canada J4G 1A1

Attention: Customer First Centre (CFirst)

REF: CFirst (24-hour service)

Toll Free - USA and Canada: 1-800-268-8000

Toll Free - International: (International Access Code) + 8000-268-8000

Other: 1-450-647-8000

FAX: 1-450-647-2888

E-mail: CFirst@pwc.ca

3. Maintenance Concept

The engine maintenance functions detailed in this manual fall into two categories: Line Maintenance and Heavy Maintenance. Repairs beyond the levels detailed in this manual are not recommended and should be accomplished by an approved overhaul facility.

A. Line Maintenance

The scope of line maintenance consists of the removal and installation of external components and engine accessories. All procedures are to be considered line maintenance in the absence of the words "(Heavy Maintenance Only)" appearing with procedure title in Maintenance Practices.

B. Heavy Maintenance

Heavy maintenance details Hot Section Refurbishment, repair and component removal considered beyond the normal capabilities of a typical line maintenance shop. The scope of Heavy Maintenance includes the removal and installation of engine internal components and limited repairs to hot section area components. Instructions are given with the understanding that Chapter 70, STANDARD PRACTICES - MAINTENANCE PROCEDURES, has been read, entirely understood and will be followed.

4. Supplementary Publications

Personnel concerned with the engine maintenance of should familiarize themselves with the content of the JT15D-5/JT15D-5R Illustrated Parts Catalog, P&WC Manual P/N 3033442, which lists and describes the saleable parts of the engine and illustrates their inter-relationship.

5. Service Bulletins

Service bulletins will be issued as required to provide information or instructions for modifying engines or parts to the latest configuration.

6. Special Tool Service Bulletins

Special Tool Service Bulletins, P/N 3034554, provide instructions for modifying special tools to a later configuration.

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7. Suppliers and Supplier Services

The names of any companies provided in this publication as a possible source for required services or supplies are furnished for information purposes only. Pratt & Whitney Canada does not endorse the work performed or supplies procured from these companies. Furthermore, Pratt & Whitney Canada does not accept responsibility, to any degree, for the selection of such companies for such work performed or supplies procured.

8. Build Specification (BS)

The following build specifications are applicable throughout this manual. The appropriate BS is recorded on the engine data plate.

JT15D-5 Engines

BS636 - Cessna Citation II (T-47A)
BS657 - Beechjet T-400
BS713 - Beechjet T-400
BS1191 - Raytheon Hawker 400XP (Post-SB7600 Engines)

JT15D-5R Engines

BS1220 - Beechjet T-400
BS1221 - Raytheon Hawker 400XP

9. How to Use this Manual

A. Chapter/Section/Subject Numbering

(1) Subject matter in this manual is separated into specific Chapters, Sections and Subjects in accordance with ATA Specification No. 100. Each Chapter is divided into sections and each section is divided into subjects. These three elements are shown in large bold numbers at the lower right hand corner of each page, where applicable. Chapters are separated by yellow tab dividers.

(2) Chapters contained in this manual are as follows:

AIRWORTHINESS LIMITATIONS	Life Limited Parts
70	Standard Practices
71	Power Plant
72	Engine
73	Fuel System
74	Ignition System
75	Air System
77	Engine Indicating System
79	Oil System

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10. Engine Part Nomenclature

For engine areas, stations, flanges and bearings, refer to Chapter 72-00-00, Description and Operation.

11. Directional References

The terms right and left, clockwise and counterclockwise, upper and lower and similar references will apply to the engine as viewed (unless otherwise specified) from the rear, with the engine in a horizontal position.

12. Abbreviations

The following is a list of abbreviations used throughout this manual:

AGB	Accessory Gearbox
AMM	Aircraft Maintenance Manual
AMS	Aerospace Material Specification
AOG	Aircraft on Ground
ASSY	Assembly
ATA	Air Transportation Association
BS	Build Specification
BVC	Bleed Valve Controller
°C	Degrees Celsius
cc	Cubic Centimeters
CCW	Counterclockwise
CG	Center of Gravity
cpm	Cycles per Minute
CW	Clockwise
Dia.	Diameter
d.c.	Direct Current
Dim.	Dimension
EEC	Electronic Engine Control
EGT	Exhaust Gas Temperature
EMF	Electromotive Force
°F	Degrees Fahrenheit
Fig.	Figure
FIR	Full Indicator Reading
Fn	Net Thrust
FOD	Foreign Object Damage
FOHE	Fuel/Oil Heat Exchanger
Fwd.	Forward
HMU	Hydromechanical Metering Unit or Hydromechanical Fuel Control Unit
HP	High Pressure

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hr.	Hour
HSI	Hot Section Inspection
HSR	Hot Section Refurbishment
ID	Inside Diameter
Imp.	Imperial
ITT	Interturbine Temperature
in.	Inch
IPC	Illustrated Parts Catalog
kg	Kilogram
lb.	Pound
lb.in./lbf.in	pound force inch
LE	Leading Edge
LH	Left Hand
LP	Low Pressure
LRU	Line Replaceable Unit
Max.	Maximum
Min.	Minimum
mm	Millimeter
MOP	Main Oil Pressure
MOT	Main Oil Temperature
N1	Low-pressure Rotor (Fan) Speed
N2	High-pressure Rotor (Gas Generator) Speed
OD	Outside Diameter
OAT	Outside Air Temperature
O/H	Overhaul
oz.	Ounce
P3	Compressor Discharge Pressure
Pamb	Ambient Engine Inlet Pressure
Pc	Compressor Discharge Pressure
PD	Pitch Diameter
P/N	Part Number
Poil	Oil Pressure
PLA	Power Lever Angle
Psa	Accessory Gearbox Static Presure
Psd	Bypass Duct Static Presure
psi	Pounds per Square Inch
psia	Pounds per Square Inch (absolute)
psig	Pounds per Square Inch (gage)
Pto	Engine Inlet Total Pressure
P&WA	Pratt and Whitney Aircraft
P&WC	Pratt and Whitney Canada
PWC	Special Tool and Consumable Material Prefix Letters

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The export control classification with respect to this document is contained on the back of the title page.

Ref.	Reference
RH	Right Hand
rpm	Revolutions per Minute
SB	Service Bulletin
sec.	Second
SG	Specific Gravity
SPOP	Service Process Operation Procedure
T5	Interturbine Temperature (ITT)
tamb	Ambient Air Temperature
TBA	To Be Advised
TBD	To Be Determined
TBO	Time Before Overhaul
TBV	Thermostatic Bypass Valve
TDC	Top Dead Center
Temp	Temperature
TIG	Tungsten Inert Gas (Welding Method)
UOS	Unless Otherwise Specified
V	Volt
W	Watt
WOW	Weight on Wheels

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SPECIAL TOOLS/FIXTURES AND EQUIPMENT

1. Special Tools

   A. General

   This section contains data about the special tools and the fixtures and equipment listed in this manual.

   Special tools required to maintain the engine are listed on Table 1. The number at the bottom center of each tool illustration is the P&WC tool number. Tool quantity, if more than one required, is shown after the nomenclature.

   B. Ordering Special Tools

   Depending on the geographical location of the operator, requests for the purchase of the special tools listed in Table 1 should be addressed as given in SIL GEN-022.

   DELETED.

   NOTE: DELETED.

2. Special Tools

   Special tools required to maintain the engine are listed on Table 1 and illustrated on figures which follow.

TABLE 1, Special Tools

Part No.	Name	CH/SE/SU	Maintenance Level		
			Line	Heavy	HSI
PWC30128-02	Puller, Anti-icing Air Tube	75-00-02	X		
PWC30128-05	Puller, Gas Generator Case Drain Tubes	73-10-06		X	
PWC30128-06	Puller, No.4 Bearing Pressure/Scavenge Oil Tubes	72-50-06		X	X
PWC30128-07	Puller, Oil Filler Tube Blank	70-00-00	X		
PWC30271	OBSOLETE: Replaced By PWC31771				
PWC30304-09	Set, HP Turbine Disk or Post-SB7306 Bellcrank and No.4 Bearing Housing Cover Bolt Rivets	72-50-02 72-50-06		X	X
PWC30304-10	Set, HP Turbine Disk Balancing Rivets	72-50-02		X	X
PWC30304-11	Set, LP Compressor Disk Balancing Rivets	72-30-03		X	

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The export control classification with respect to this document is contained on the back of the title page.

TABLE 1, Special Tools (Cont'd)

Part No.	Name	CH/SE/SU	Maintenance Level		
			Line	Heavy	HSI
PWC30304-12	Set, LP Compressor Disk Balancing Rivets	72-30-03		X	
PWC30304-18	Set, Post-SB7306 Bellcrank and No.4 Bearing Housing Cover Bolt Rivets	72-50-06		X	
PWC31000	Maintenance Stand	72-00-00		X	X
PWC31002	OBSOLETE				
PWC31013	Puller, AGB Retaining Pin	72-60-01	X		
PWC31016	Socket, LPT Retaining Bolt	72-50-03		X	
PWC31018	Stand, LPT Rotor	72-50-03		X	X
PWC31031	Fixture, Fuel Nozzle Adapters (two required)	73-10-05		X	X
PWC31034	Replaced by PWC31534				
PWC31035	OBSOLETE: replaced by PWC31835				
PWC31036	Socket, Inlet Cone Bolt	72-30-03		X	X
PWC31046	OBSOLETE: replaced by PWC31546				
PWC31047	Sleeve, LP Compressor Rotor	72-30-03		X	X
PWC31050	OBSOLETE: replaced by PWC41050	72-30-03 72-50-02 72-50-03		X	X
PWC31058	Adapter, Rear Engine Mount	72-40-01			X
PWC31061	Puller, AGB Carbon Seal	72-60-02	X		
PWC31062	Drift, AGB Carbon Seal	72-60-02	X		
PWC31063	Support, AGB Centrifugal Breather Adapter	72-60-02	X		
PWC31065	OBSOLETE: replaced by PWC31865				
PWC31068	OBSOLETE: REPLACED BY PWC31668				
PWC31069	OBSOLETE: replaced by PWC31369		X		
PWC31071	Riveter, Shroud Segments Retaining Ring	72-50-01	X		

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The export control classification with respect to this document is contained on the back of the title page.

TABLE 1, Special Tools (Cont'd)

Part No.	Name	CH/SE/SU	Maintenance Level		
			Line	Heavy	HSI
PWC31073-01	Fitting, Fuel Nozzle Inlet Adapter (two required)	73-10-05			X
PWC31073-02	Fitting, Fuel Nozzle Inlet Adapter	73-10-05			X
PWC31074	OBSOLETE: replaced by PWC31374				
PWC31077	OBSOLETE				
PWC31078	OBSOLETE				
PWC31079	Puller, HPT Shroud Segments Retaining Ring	72-50-01		X	X
PWC31083	OBSOLETE: REPLACED BY PWC31683				
PWC31084	Spacer, HPT Shroud Segment Grinding (four required)	72-50-02		X	X
PWC31086	Test Rig	73-10-05		X	X
PWC31092	Drift, Seal, Starter-Generator Mount Pad	72-60-02	X		
PWC31195	Clips, Retaining, Sealing Rings	72-40-01 72-50-01		X	X
PWC31237	OBSOLETE: replaced by PWC31737				
PWC31260	Extractor (Pre-SB7322), Rear Engine Mount Bolt	72-00-00 72-70-04		X	X
PWC31261	Plug, Fuel Nozzle Inlet	73-10-05		X	X
PWC31262	Puller Pre-SB7322, Rear Engine Mount Bolt	72-00-00 72-70-04		X	X
PWC31263	Cap, Fuel Nozzle Adapter Pressure Check (12 required)	73-10-05		X	X
PWC31274	Puller, No. 4 Bearing Carbon Seal	72-50-06		X	X
PWC31275	Drift, No. 4 Bearing, Carbon Seal	72-50-06	X		
PWC31276	Plug, Blanking, Ignition Exciter Box	72-50-06	X		
PWC31327	Collar Adapter, HP Turbine Shaft Nut	72-50-02		X	X

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TABLE 1, Special Tools (Cont'd)

Part No.	Name	CH/SE/SU	Maintenance Level		
			Line	Heavy	HSI
PWC31350	Puller, LPT Rotor	72-50-03		X	X
PWC31369	Spreader, LP Turbine Bolt Keywasher	72-50-03		X	X
PWC31374	Locking Tool, LP Turbine Shaft Bolt Keywasher	72-50-03		X	X
PWC31382-01	Extractor, AGB Main Shaft Oil Seal	72-60-02	X		
PWC31382-02	Extractor, Fuel Pump and Oil Pump Accessory Drive Oil Seals	72-60-02	X		
PWC31400	Adapter, Fan Shaft (Pre-SB7318)	72-30-03		X	
PWC31461	OBSOLETE: replaced by PWC52094				
PWC31503	Engine Sling	72-00-00	X		
PWC31511	Plug, Blanking	72-50-02		X	X
PWC31512	Cap, Blanking	72-50-01 72-50-03		X	X
PWC31515	Extension Bar (Pre-SB7318)	72-30-03	X		
PWC31516	Guide, OPRV Sleeve	79-20-01	X		
PWC31517	Drilling Fixture, HP Turbine Shaft Locking Nut	72-50-02		X	X
PWC31534	OBSOLETE: Replaced by PWC32505 tool set				
PWC31540	Wrench, HP Compressor Rotating	72-00-00	X		
PWC31546	Adapter, LP Turbine Retaining Bolt	72-50-03		X	X
PWC31562	Pusher, No.4 Bearing Carbon Seal	72-50-06		X	X
PWC31563	Drift , No.4 Bearing Carbon Seal	72-50-06		X	
PWC31571	Adjusting Wrench, Oil Pressure Relief Valve	79-20-01	X		
PWC31572	Base, No.4 Bearing Housing Cover	72-50-06		X	X

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE 1, Special Tools (Cont'd)

Part No.	Name	CH/SE/SU	Maintenance Level		
			Line	Heavy	HSI
PWC31573	Plug, No.4 Bearing Hsg. Cover Oil Passage	72-50-06		X	X
PWC31574	Cap , Blanking, No.4 Bearing Hsg. Cover Oil Passage	72-50-06		X	X
PWC31577	Extension Bar, LP Turbine Retaining Bolt	72-50-03		X	X
PWC31587	Riveter, Fan Balance Rivets	72-30-03		X	
PWC31604	Puller, Fan Case	72-30-01		X	
PWC31632	Puller, LP Compressor	72-30-03		X	
PWC31636	Pad, HP Turbine Shaft	72-50-02		X	X
PWC31638	OBSOLETE: replaced by PWC52079				
PWC31642	Holder, No. 4 Bearing Housing Cover T-headed Bolt	72-50-06		X	X
PWC31650	Ring, HP Turbine Disk	72-50-02		X	X
PWC31651	Adapter , LP Turbine Removal	72-50-03		X	X
PWC31654	Puller, No.3 Bearing Rotor Air Seal	72-50-02		X	X
PWC31656	Puller, HPT Air Seal	72-50-01		X	X
PWC31660	Puller, OPRV Sleeve	79-20-01	X		
PWC31661	Overspeed Control Setting Gage	72-50-06		X	X
PWC31664	Puller, Intershaft Oil Transfer Tube	72-50-03		X	X
PWC31668	Grinding Fixture, HP Turbine Shroud Segments	72-50-01		X	X
PWC31669	Grinding Wheel, Shroud Segments - use with PWC31668	72-50-01		X	X
PWC31670	Dresser, Grinding Wheel	72-50-01		X	X
PWC31680	Puller, Check Valve Housing	79-20-02	X		
PWC31683	Radius Gage, Shroud Segments	72-50-01		X	X
PWC31685	OBSOLETE: REPLACED BY PWC31885				

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TABLE 1, Special Tools (Cont'd)

Part No.	Name	CH/SE/SU	Maintenance Level		
			Line	Heavy	HSI
PWC31687	Riveter, HPT Disk /Post-SB7306 Bellcrank, No.4 Bearing Hsg. Cover Bolts			X	X
PWC31690	Puller, Inlet Cone	72-30-03		X	X
PWC31734	Puller, HP Turbine	72-50-02		X	X
PWC31737	Locking Tool, HP Turbine Disk Cupwasher	72-50-02		X	X
PWC31771	Spreader, Shanknut	70-00-00		X	X
PWC31772	Puller, Cabin Bleed Air Tube (replaces PWC31272)	72-00-00	X		
PWC31865	Collar, HP Turbine Shaft Nut	72-50-02		X	X
PWC31871	Adjusting Wrench, Oil Pressure Relief Valve	79-20-01	X		
PWC31885	Adapter, HP Turbine Shroud Segments Grinding	72-50-01		X	X
PWC32122-52	OBSOLETE: REPLACED BY PWC31669				
PWC32507	Pump, Hydraulic	72-30-03 72-50-02 72-50-03		X	X
PWC32550	Anti-rotation Adapter, Power Wrench (Post-SB7318)	72-30-03 72-50-02 72-50-03		X	X
PWC34913	Holding Fixture, Borescope Inspection	72-00-00		X	X
PWC41050	Wrench, Main Rotor Fasteners (Post-SB7318)	72-30-03 72-50-02 72-50-03		X	X
PWC52076	Socket, Fan Shaft (Post-SB7318)	72-30-03		X	X
PWC52077	Adapter, Fan Shaft (Post-SB7318)	72-30-03		X	X
PWC52079	Locking Tool (Pre-SB7426)	72-30-03		X	X
PWC52080	Socket Support Bridge (Post-SB7318)	72-30-03		X	
PWC52092	Velocity Sensor Adapter	72-30-03	X		

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TABLE 1, Special Tools (Cont'd)

Part No.	Name	CH/SE/SU	Maintenance Level		
			Line	Heavy	HSI
PWC52094	Socket, LP Compressor Shaft (Pre-SB7318; replaces PWC31461)	72-30-03	X		
PWC52111	Drift, No. 4 Bearing Housing Sleeve	72-50-06		X	X
PWC52112	Drift, No. 4 Bearing Housing Sleeve	72-50-06		X	X
PWC52161	Gage, Fuel Pressure Manifold Pressure Check	71-00-00	X		
PWC52294	Wrench, Post-SB7493/ Post-SB7526 Fuel Nozzles	73-10-05		X	
PWC52357	Pusher/Puller, Ferrule (Post-SB7452)	72-50-03		X	X
PWC52366	Crimper, Fan Locking Nut Cupwasher (Post-SB7436)	72-30-03		X	
PWC52445	Wrench, Seating, LP Compressor Inlet Cone	72-30-03		X	X
PWC52451	Driver, Lapping	79-21-01	X	X	
PWC52471	Wash Tube	71-00-00	X		
PWC52509	Cap-off Tool (qty.12)	73-10-05		X	X
PWC52594	Fan Pad Booster	72-30-03		X	
PWC52595	Shaft Pusher Pad	72-30-03		X	
PWC52596	Disk Drift	72-50-02		X	X
PWC52609	Stub Shaft Drift	72-50-02		X	X
PWC52693	Plug, Leakage Check, Post-SB7598 Fuel Manifold Inlet Adapter	73-10-05		X	X
PWC52701	Plug, Leakage Check, Post-SB7598 Fuel Manifold Inlet Adapter	73-10-05		X	X
PWC52820	Pusher (Replaces PWC52619)	72-50-03		X	X
PWC60769	Resizer, Actuating Rod Seal Post-SB7309/Post-SB7384	72-50-06		X	X
PWC66810	Drift, Seal, Fuel Control and Spare Accessory Drive Mount Pads	72-60-02	X		

P&WC Proprietary Information. Subject to the restriction on the title page.
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TABLE 1, Special Tools (Cont'd)

Part No.	Name	CH/SE/SU	Maintenance Level		
			Line	Heavy	HSI
PWC71392	Hydraulic Adapter (Replaces PWC32505)	72-50-02		X	X
PWC89837	Hydraulic Cylinder (Replaces PWC32506)	72-30-03 72-50-02 72-50-03		X	X

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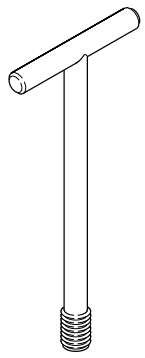
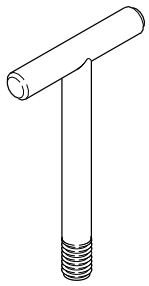
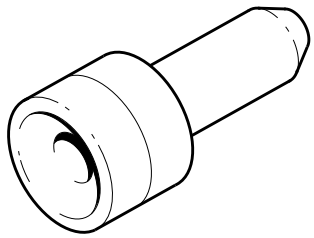
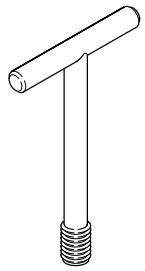
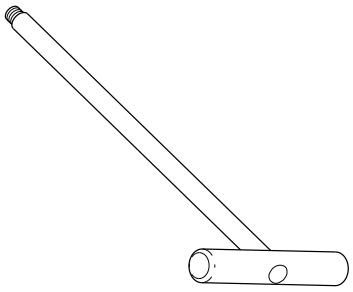
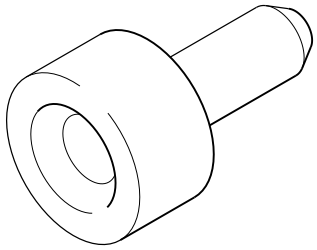
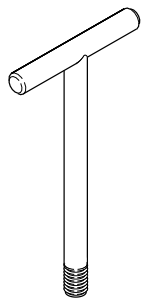
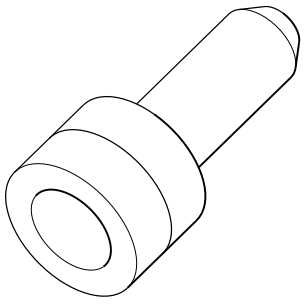
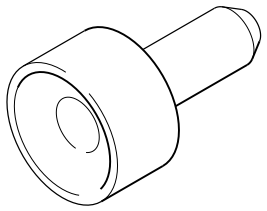
PWC30128-02 	PWC30128-07 	PWC30304-10 
PWC30128-05 	PWC30271 	PWC30304-11 
PWC30128-06 	PWC30304-09 	PWC30304-12 

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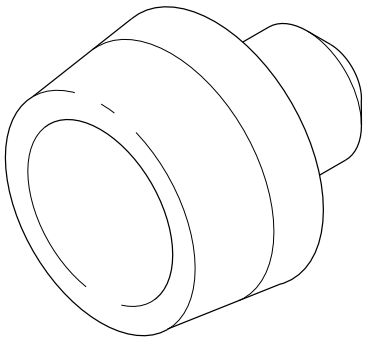
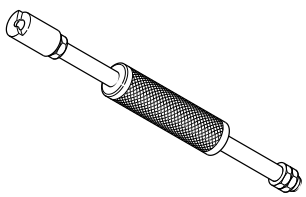
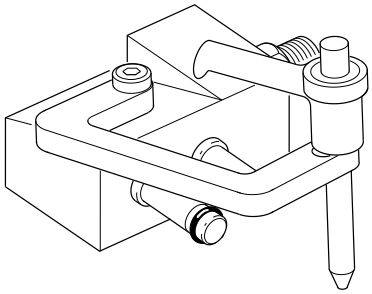
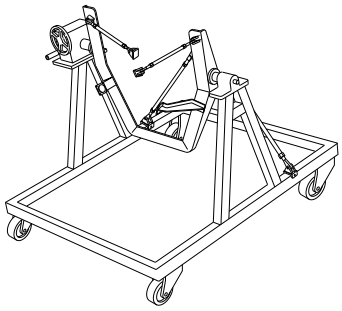
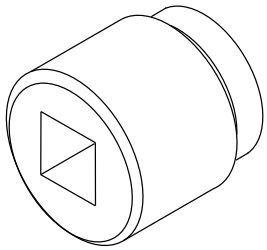
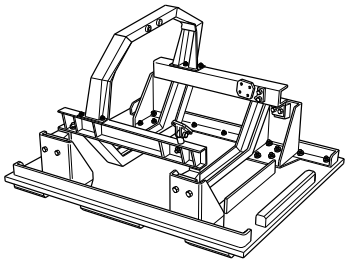
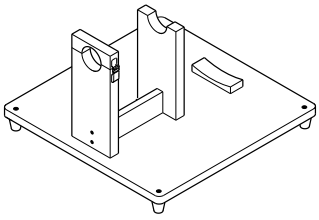
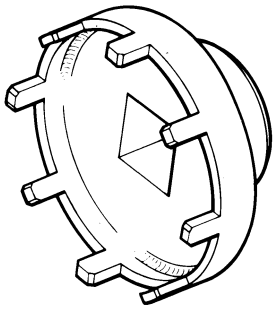
PWC30304-18 	PWC31013 	PWC31031 
PWC31000 	PWC31016 	PWC31034 **TOOL NOT ILLUSTRATED**
PWC31002 	PWC31018 	PWC31035 

Special Tool Illustrations

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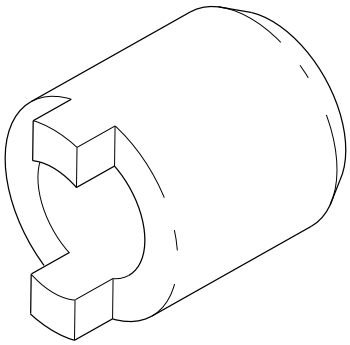
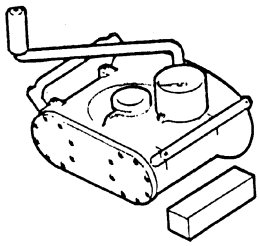
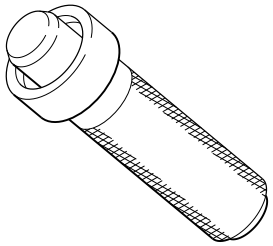
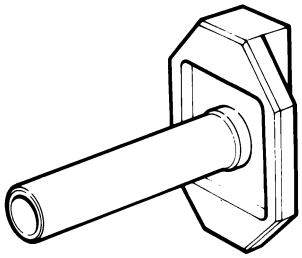
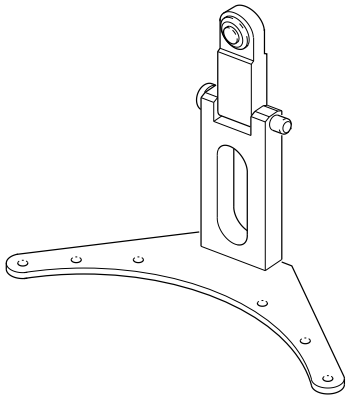
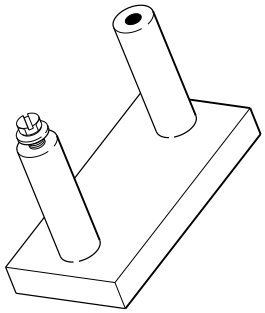
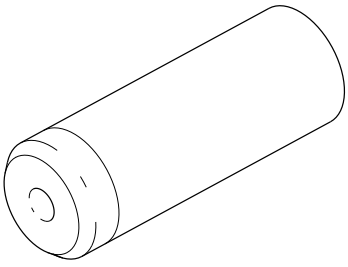
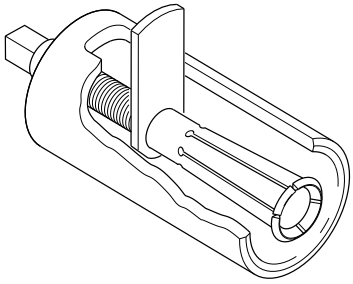
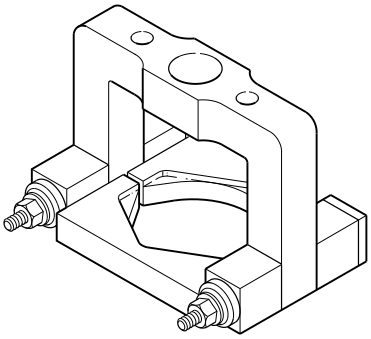
PWC31036 	PWC31050 	PWC31062 
PWC31046 	PWC31058 	PWC31063 
PWC31047 	PWC31061 	PWC31065 

Special Tool Illustrations

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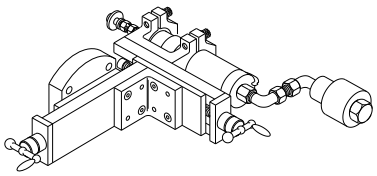
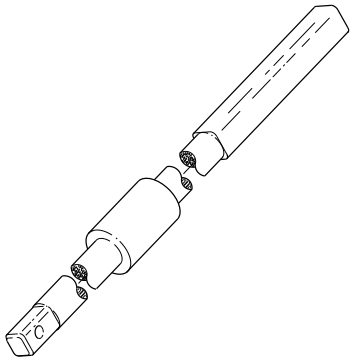
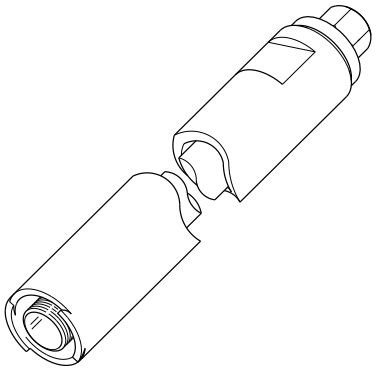
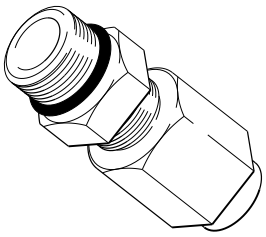
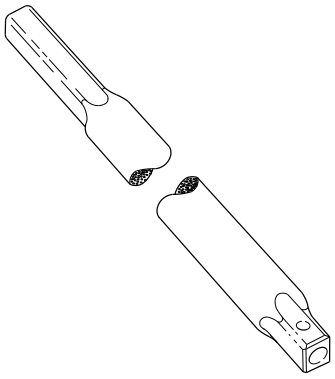
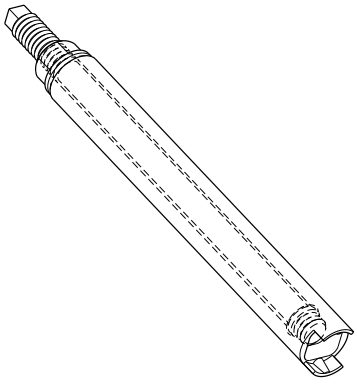
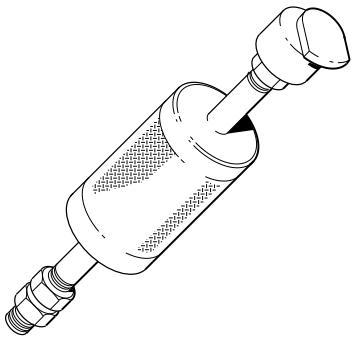
PWC31068 	PWC31073-01 **TOOL NOT ILLUSTRATED**	PWC31077 
PWC31069 	PWC31073-02 	PWC31078 
PWC31071 **TOOL NOT ILLUSTRATED**	PWC31074 	PWC31079 

Special Tool Illustrations

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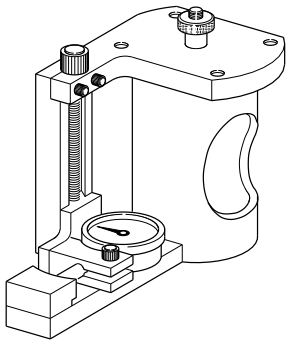
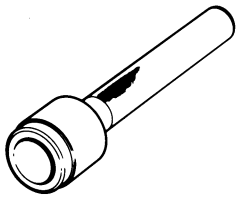
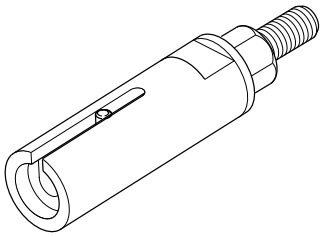
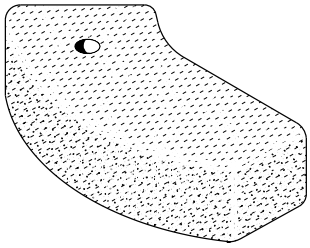
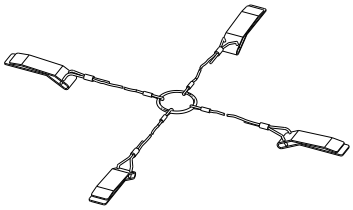
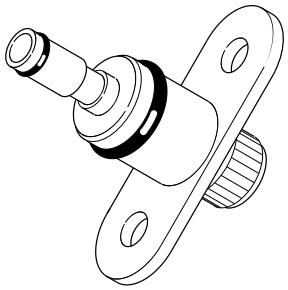
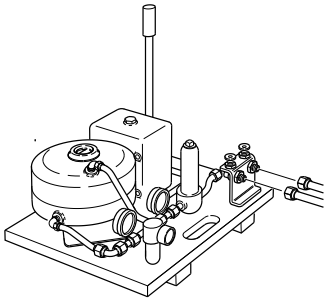
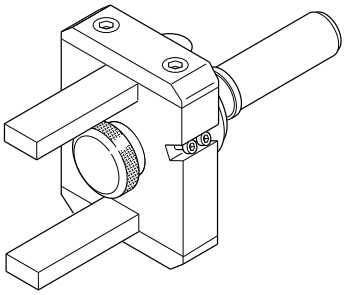
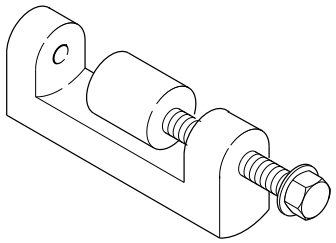
PWC31083 	PWC31092 	PWC31260 
PWC31084 	PWC31195 	PWC31261 
PWC31086 	PWC31237 	PWC31262 

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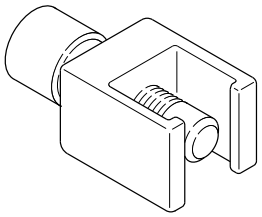
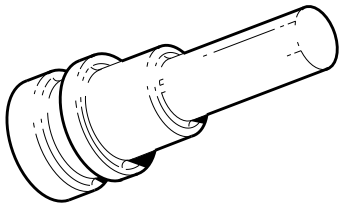
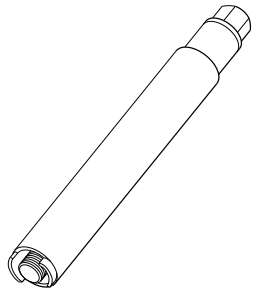
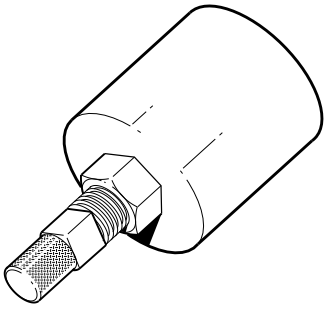
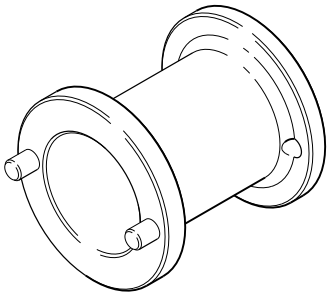
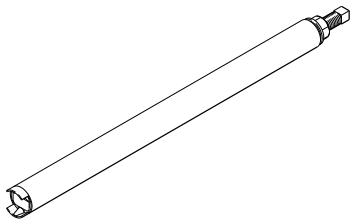
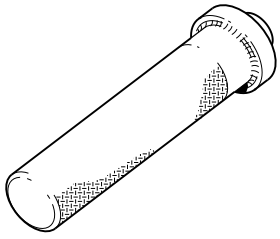
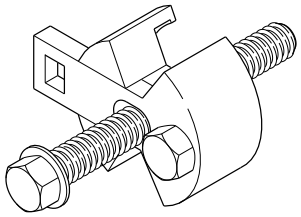
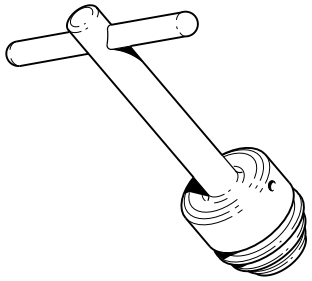
PWC31263 	PWC31276 	PWC31369 
PWC31274 	PWC31327 	PWC31374 
PWC31275 	PWC31350 	PWC31382-01 

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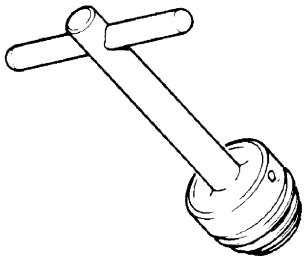
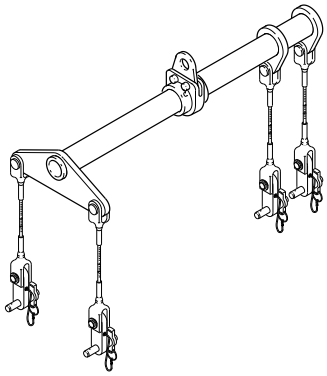
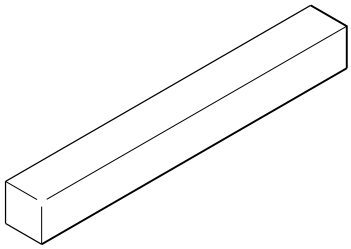
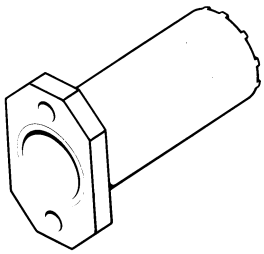
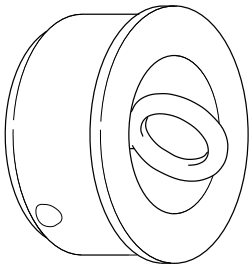
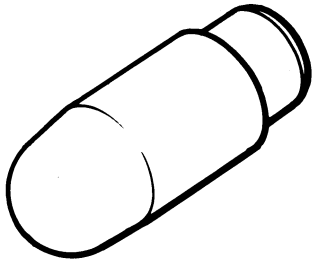
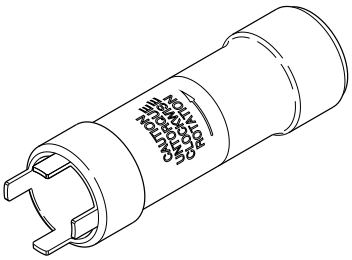
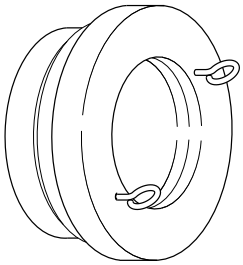
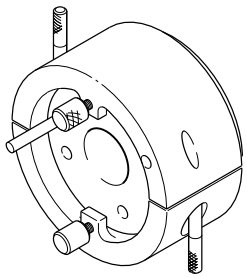
PWC31382-02 	PWC31503 	PWC31515 
PWC31400 	PWC31511 	PWC31516 
PWC31461 	PWC31512 	PWC31517 

Special Tool Illustrations

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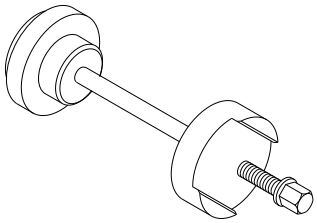
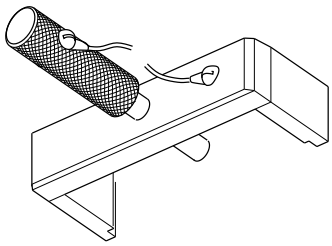
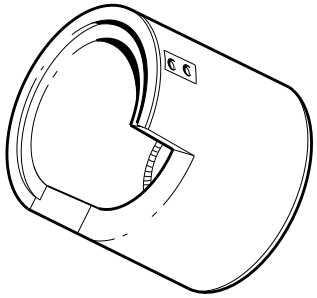
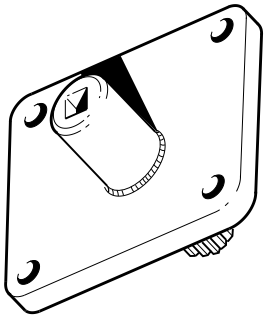
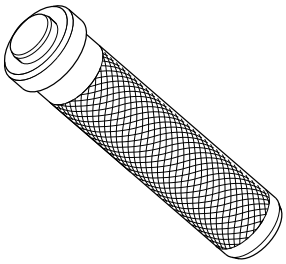
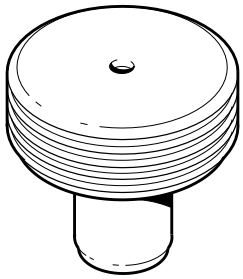
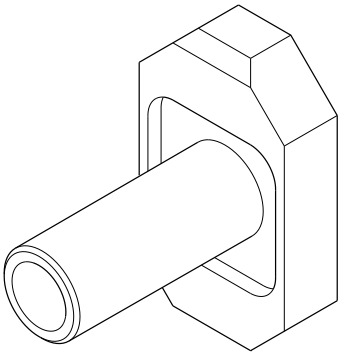
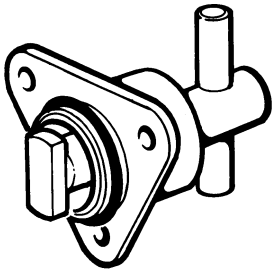
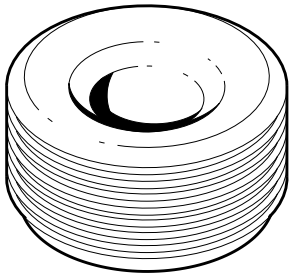
PWC31534 	PWC31562 	PWC31572 
PWC31540 	PWC31563 	PWC31573 
PWC31546 	PWC31571 	PWC31574 

Special Tool Illustrations

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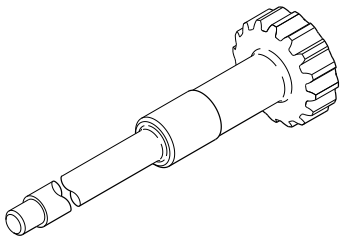
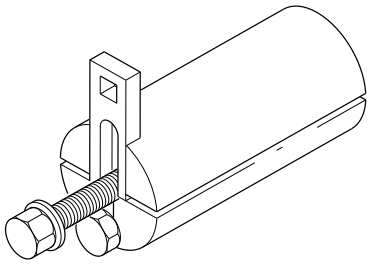
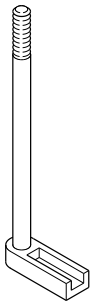
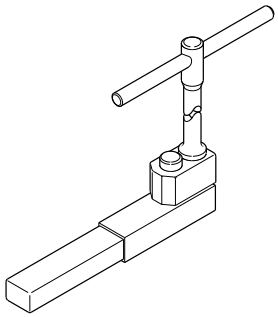
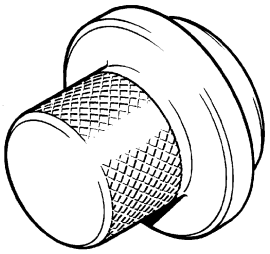
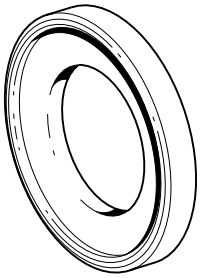
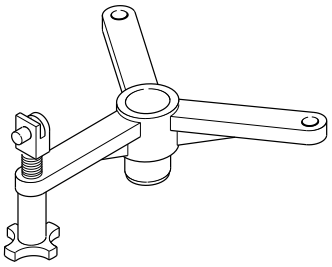
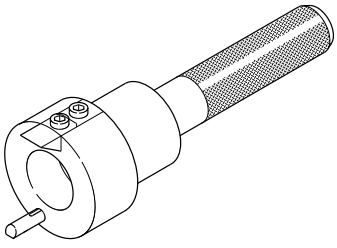
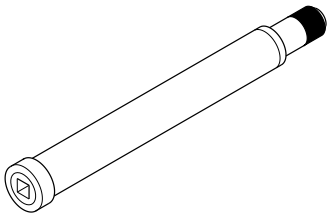
PWC31577 	PWC31632 	PWC31642 
PWC31587 	PWC31636 	PWC31650 
PWC31604 	PWC31638 	PWC31651 

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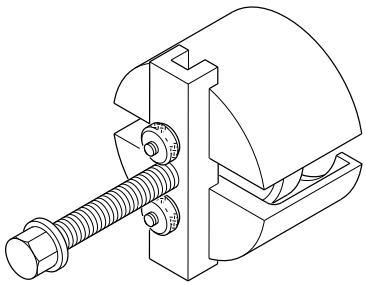
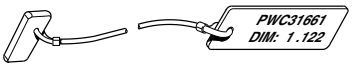
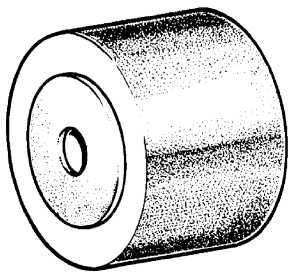
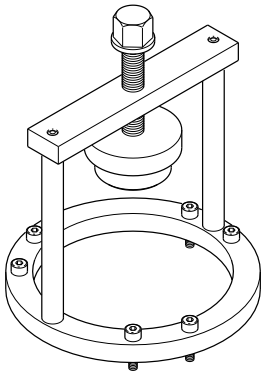
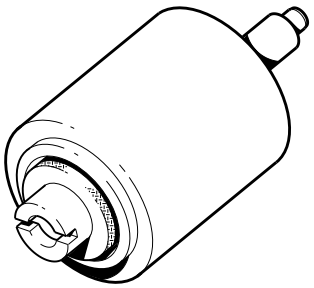
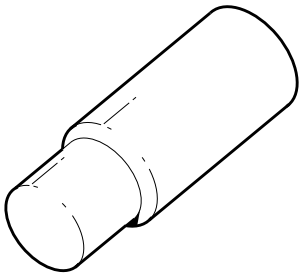
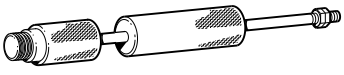
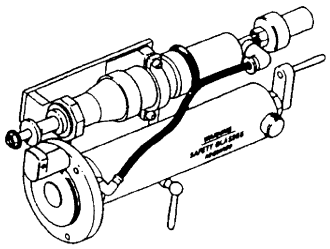
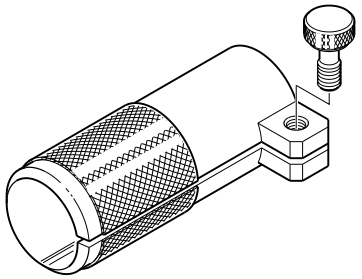
PWC31654 	PWC31661 	PWC31669 
PWC31656 	PWC31664 	PWC31670 
PWC31660 	PWC31668 	PWC31680 

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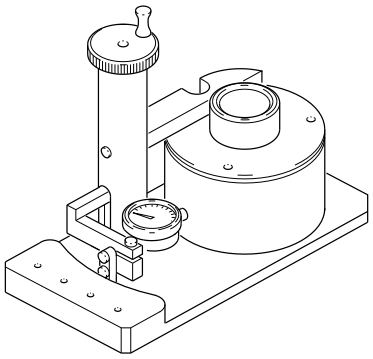
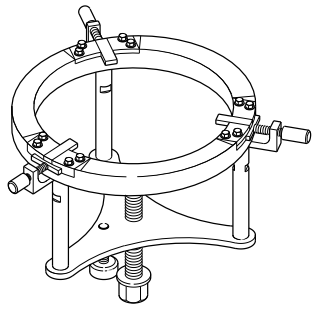
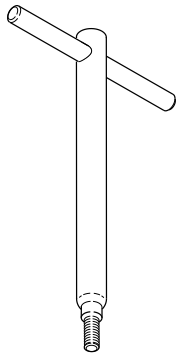
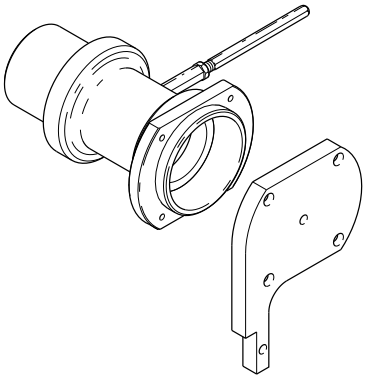
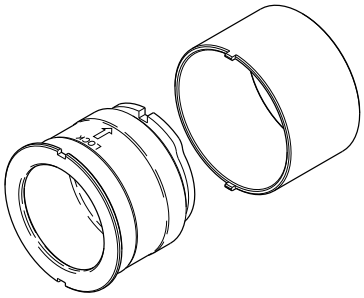
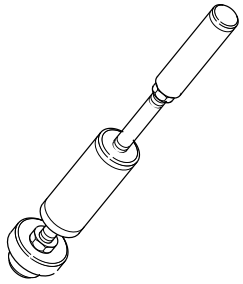
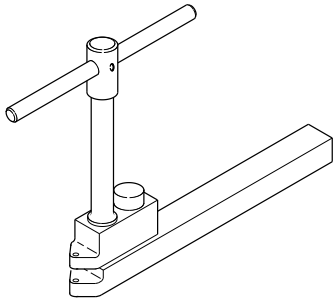
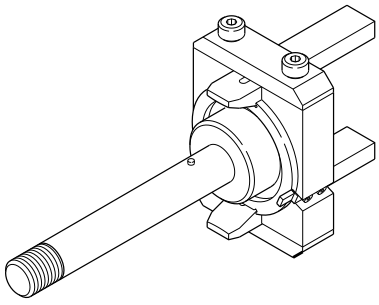
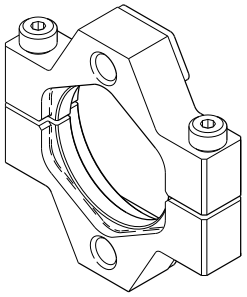
PWC31683 	PWC31690 	PWC31771 
PWC31685 	PWC31734 	PWC31772 
PWC31687 	PWC31737 	PWC31865 

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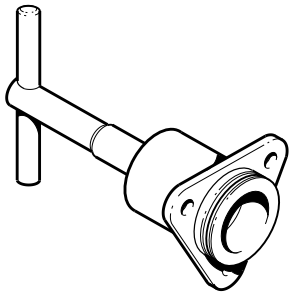
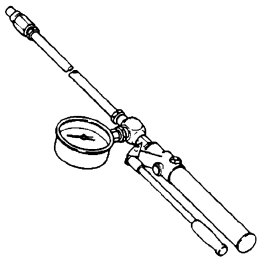
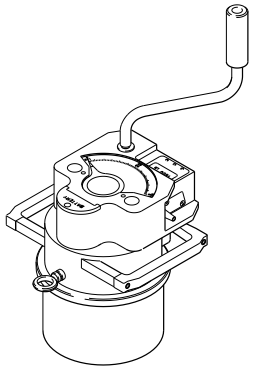
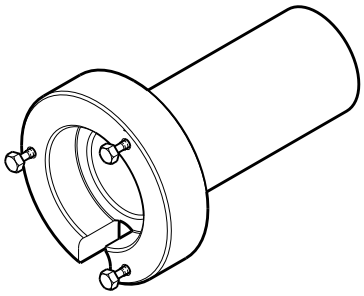
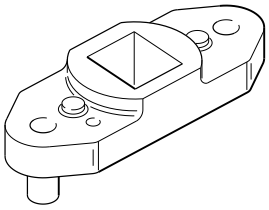
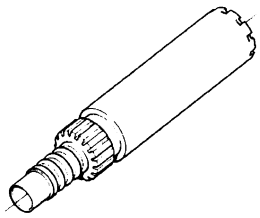
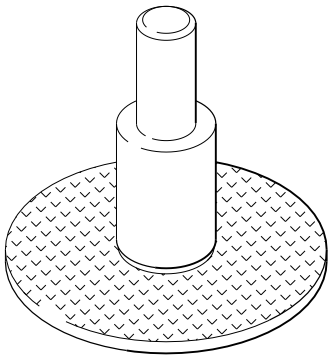
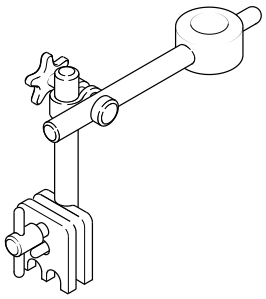
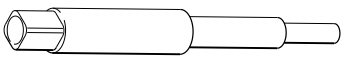
PWC31871 	PWC32507 	PWC41050 
PWC31885 	PWC32550 	PWC52076 
PWC32122-52 	PWC34913 	PWC52077 

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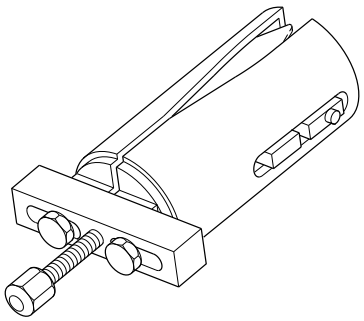
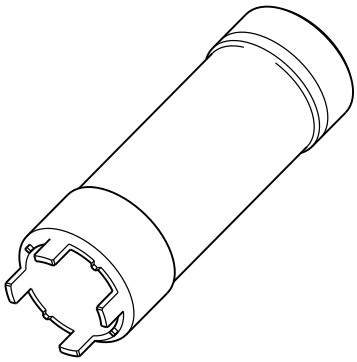
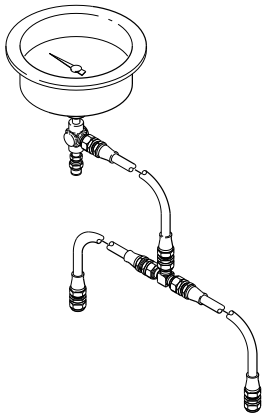
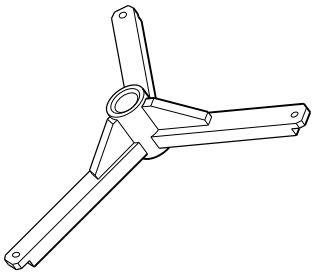
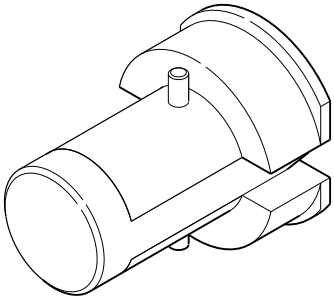
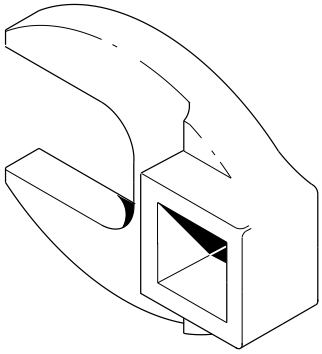
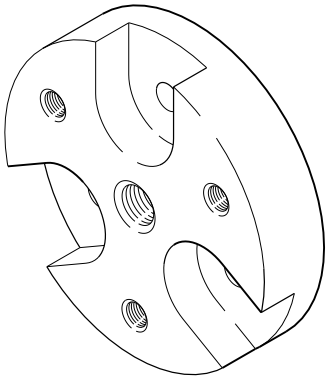
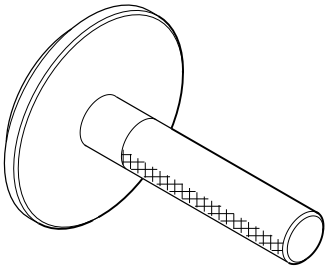
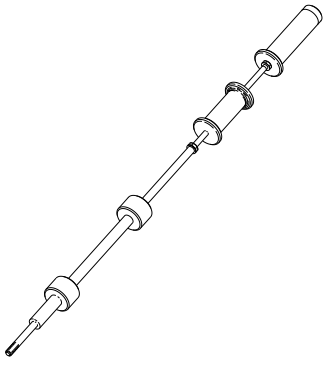
PWC52079 	PWC52094 	PWC52161 
PWC52080 	PWC52111 	PWC52294 
PWC52092 	PWC52112 	PWC52357 

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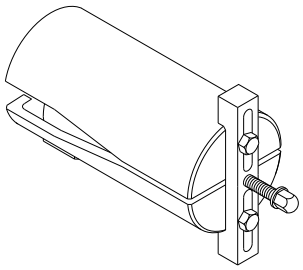
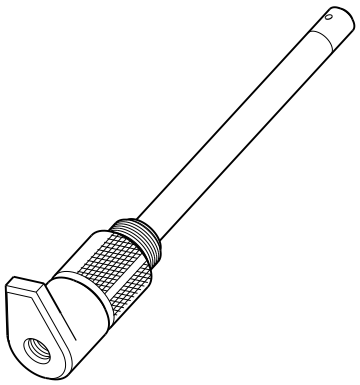
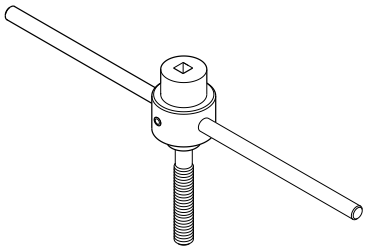
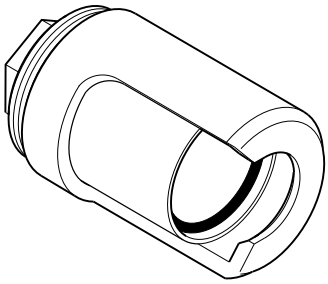
PWC52366 	PWC52471 	PWC52595 **TOOL NOT ILLUSTRATED**
PWC52445 	PWC52509 	PWC52596 **TOOL NOT ILLUSTRATED**
PWC52451 **TOOL NOT ILLUSTRATED**	PWC52594 **TOOL NOT ILLUSTRATED**	PWC52609 **TOOL NOT ILLUSTRATED**

Special Tool Illustrations

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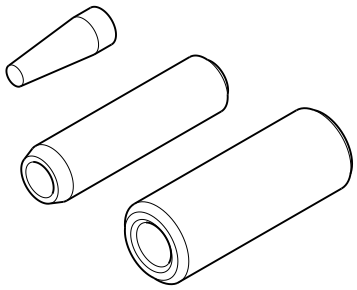
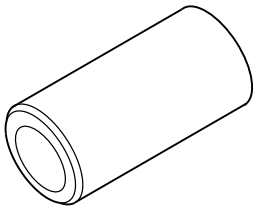
PWC52693 **TOOL NOT ILLUSTRATED**	PWC60769 	PWC89837 **TOOL NOT ILLUSTRATED**
PWC52701 **TOOL NOT ILLUSTRATED**	PWC66810 	
PWC52820 **TOOL NOT ILLUSTRATED**	PWC71392 **TOOL NOT ILLUSTRATED**	

Special Tool Illustrations

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3. Torque Wrench

A. General

For detailed operating instructions and information about calibrating the PWC31050 or PWC41050 Torque Wrench, refer to manufacturer's manual or to:

Industrial Tool Division of Bidwell Industrial Group Inc.
2055 South Main Street
Middletown, CT 06457
USA

TEL: (860) 343 - 6640
FAX: (860) 343 - 6642

B. Torque Wrench PWC31050

The torque wrench includes a completely mechanical drive system and utilizes a power reduction gear-train. The torque indicator is calibrated in 50 lb.ft. increments and is a direct reading of the output torque of the wrench. A small hand crank allows manual operation of the wrench, although power tools, such as air or electrically-driven motors, may be used for faster operation. The output of the wrench is a standard ¾ inch square drive, with the counteracting load taken by two ½-inch pins on the back of the wrench. The tool is used in conjunction with adapters which absorb the counteracting load.

Used with sockets and adaptive tooling, the PWC31050 wrench will hold a threaded fastener stationary while turning its rotor.

C. PWC31050 Operation

(1) Tightening

CAUTION: DO NOT USE IMPACT-TYPE MOTOR -DRIVEN DEVICES OF ANY KIND TO OPERATE WRENCH

(a) Install applicable socket tool on nut or threaded fastener to be tightened.

(b) Install applicable counteracting torque adapter on unit to be assembled.

NOTE: Steps (a) and (b), may be reversed as necessary.

(c) Install wrench onto counteracting torque adapter by engaging the two pins.

CAUTION: THE DIRECTION IS CLOCKWISE FOR THE HP AND LP TURBINES, WHERE THE OUTPUT IS ATTACHED TO THE NUT. THE DIRECTION IS COUNTERCLOCKWISE FOR THE LP COMPRESSOR, WHERE THE COUNTERACTING TORQUE ADAPTER IS ATTACHED TO THE NUT.

(d) Insert ¾ inch square drive bar into wrench and rotate and/or turn ratcheter , located on front of wrench, in same direction as output ¾ inch square . Bar is to be driven until bar engages socket.

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(e) Insert crank handle in 3/8 inch square hole in input shaft and turn in same direction as 3/4 inch output. Square bar must turn in order to tighten nut.

(f) Continue to crank wrench until torque indicator shows desired torque reading.

(g) Turn crank in opposite direction until torque indicator returns to zero (green band). This removes holding pressure on nut.

NOTE: The wrench cannot be removed until all air pressure is released.

(h) Remove wrench, counteracting torque adapter and socket.

(2) Loosening

(a) Install wrench and adapter as for tightening procedure (Ref. Subpara. (1)) but reverse the direction of rotation of the ratchet and crank handle when operating wrench.

D. Torque Wrench PWC41050

CAUTION: DO NOT USE IMPACT-TYPE MOTOR DRIVEN DEVICES OF ANY KIND TO OPERATE WRENCH.

A 3/8 inch input drive socket on the torque wrench PWC41050 accepts air- or electric motor-driven tools, a hand crank or a ratchet to drive the gear train. Clockwise input produces clockwise wrench output, counterclockwise input produces counterclockwise wrench output. The wrench has a splined drive output. The counteracting load on the wrench is absorbed by adapters secured to two pins at rear of wrench, or threaded holes on front of wrench. Used with sockets and adaptive tooling, the PWC41050 wrench will hold a shaft or rotor stationary while loosening or tightening a threaded fastener.

4. Supplementary Tool Information

Tables 2 through 15 provide supplementary information on safe use, handling and maintenance of Pratt & Whitney Canada special tools.

TABLE 2, General Equipment

Criteria	Recommendation
Safety	Eye protection recommended.
	Protective footwear recommended.
Quality	Visually check for damage or wear prior to each use.
Maintenance	Clean and lubricate as required.
Use	Refer to appropriate P&WC engine manual for detailed usage information.

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TABLE 3, Torque Related Equipment

Criteria	Recommendation
Safety	Eye protection recommended.
	Protective footwear recommended.
	Do not exceed maximum working load if stated.
Quality	Visually check for damage or wear prior to each use.
Maintenance	Clean and lubricate as required.
Use	Refer to appropriate P&WC engine manual for detailed usage information.

TABLE 4, Load Carrying Equipment

Criteria	Recommendation
Safety	Eye protection recommended.
	Protective footwear recommended.
	Do not exceed maximum working load.
Quality	Visually check for damage or wear prior to each use.
Maintenance	Clean and lubricate as required.
Inspection	NDT inspect periodically if used under severe conditions.
	Static load test at 125% of indicated maximum working load periodically unless otherwise specified.
	Certificate of conformance required upon receipt of new tool.
Use	Refer to appropriate P&WC engine manual for detailed usage information.

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TABLE 5, Blade Installation Equipment

Criteria	Recommendation
Safety	Eye protection recommended.
	Protective footwear recommended.
Quality	Visually check for damage or wear prior to each use.
Maintenance	Clean and lubricate as required.
Inspection	Calibrate periodically as per S.I.L.# GEN 005.
Use	Refer to appropriate P&WC engine manual for detailed usage information.

TABLE 6, Proprietary Equipment

Criteria	Recommendation
Safety	Eye protection recommended.
	Protective footwear recommended.
	Do not exceed maximum working load.
Quality	Visually check for damage or wear prior to each use.
Maintenance	Clean and lubricate as required.
Inspection	Calibrate in accordance with manufacturers instruction manual.
Use	Refer to appropriate P&WC engine manual for detailed usage information.

TABLE 7, Predress Mechanical Equipment

Criteria	Recommendation
Safety	Eye protection recommended.
	Protective footwear recommended.
Quality	Visually check for damage or wear prior to each use.

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TABLE 7, Predress Mechanical Equipment (Cont'd)

Criteria	Recommendation
Maintenance	Clean and lubricate as required.
Inspection	Dimensionally inspect periodically.
Use	Refer to appropriate P&WC engine manual for detailed usage information.

TABLE 8, Predress Electrical Equipment

Criteria	Recommendation
Safety	Eye protection recommended.
	Protective footwear recommended.
	Do not exceed maximum working load.
Quality	Visually check for damage or wear prior to each use.
Maintenance	Clean with terminal solvent as required.
Inspection	Resistance & insulation periodically.
Use	Refer to appropriate P&WC engine manual for detailed usage information.

TABLE 9, Predress Proprietary Equipment

Criteria	Recommendation
Safety	Eye protection recommended.
	Protective footwear recommended.
	Do not exceed maximum torque value (installation).
Quality	Visually check for damage or wear prior to each use.
Inspection	Calibrate as per manufacturers instruction manual.
Use	Refer to appropriate P&WC engine manual for detailed usage information.

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TABLE 10, Critical Hydraulic Equipment

Criteria	Recommendation
Safety	Eye protection recommended.
	Protective footwear recommended.
	Do not exceed maximum working load.
Quality	Visually check for damage or wear prior to each use.
Maintenance	Clean with terminal solvent as required.
Inspection	Certificate of conformance required upon receipt of new tool.
	NDT inspect annually.
Use	Refer to appropriate P&WC engine manual for detailed usage information.

TABLE 11, Precision Equipment

Criteria	Recommendation
Safety	Eye protection recommended.
	Protective footwear recommended.
Quality	Visually check for damage or wear prior to each use.
	Store in supplied container.
Maintenance	Clean and lubricate as required.
Inspection	Dimensionally inspect periodically.
	Calibrate periodically if applicable.
Use	Refer to appropriate P&WC engine manual for detailed usage information.

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TABLE 12, Induction Heating Equipment

Criteria	Recommendation
Safety	Eye protection recommended.
	Protective footwear recommended.
Quality	Visually check for damage or wear prior to each use.
Inspection	Calibrate as per calibration schedule.
	Periodically inspect resistance, insulation & connections.
Use	Refer to appropriate P&WC engine manual for detailed usage information.

TABLE 13, Gas Pressurized Equipment)

Criteria	Recommendation
Safety	Eye protection recommended.
	Protective footwear recommended.
	Do not exceed maximum working pressure.
Quality	Visually check for damage or wear prior to each use.
Inspection	Calibrate as per manufacturers instruction manual.
	Cylinders to be maintained per local regulations.
	Pressure proof test at 125% of indicated maximum working pressure periodically unless otherwise specified.
Use	Refer to appropriate P&WC engine manual for detailed usage information.

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TABLE 14, Hydraulic Pressure Equipment

Criteria	Recommendation
Safety	Eye protection recommended.
	Protective footwear recommended.
	Do not exceed maximum working load.
Quality	Visually check for damage or wear prior to each use.
Maintenance	Clean and lubricate as required.
Inspection	Certificate of conformance required upon receipt of new tool.
Use	Refer to appropriate P&WC engine manual for detailed usage information.

TABLE 15, Ground Handling Equipment

Criteria	Recommendation
Safety	Eye protection recommended.
	Protective footwear recommended.
	Do not exceed maximum working load.
Quality	Visually check for damage or wear prior to each use.
Maintenance	Clean and lubricate as required.
Inspection	Static load test at 125% of indicated maximum working load periodically.
	Visually inspection of all structural elements with tracked records annually.
	Verify electrical continuity periodically if applicable.
	Inspect power cables, data cables and connectors periodically if applicable.
	Inspect hydraulic system for leaks periodically if applicable.

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TABLE 15, Ground Handling Equipment (Cont'd)

Criteria	Recommendation
Use	Refer to appropriate P&WC engine manual for detailed usage information.

5. Special Fixtures and Equipment

Special fixtures required to maintain the engine are listed on Table 16.

TABLE 16, Engine Test Equipment and Fixtures

ITEM NO.	PART NO.	NOMENCLATURE	SUPPLIER
1.	2312G or TT-1000A	Test Set, T6/T1 and Variable Resistor insulation resistance and continuity checks	Barfield Incorporated 4101 NW 29th Street Miami, FL 33142 USA TEL: (305) 871-3900 FAX: (305) 871-5629
2.	Model KS5518	Electrosonic Cleaner	Kell-Strom Tool Co. 214 Church Street Wethersfield, CT 06109 USA TEL: (860) 529-6851, or (860) 721-0658 (AOG service) FAX: (860) 257-9694
3.	P and H Model DA-300-HF-GW or equivalent	AC/DC Arc Welding Machine: 150 amp Min. capacity with close control in 15 to 75 amp range. (High frequency control for ease of arc starting is desirable).	Local Purchase
4.	Airco Style 8407 or equivalent	Argon Regulator	Local Purchase
5.	Airco Stock No. 8301327 or equivalent	Flowmeter Block Assemblies (2 required)	Local Purchase
6.	Linde Model HW-10 or Airco Model H35B or equivalent	Shielded Arc Torch: with provision for supply of inert gas (argon) and cooling water	Local Purchase

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TABLE 16, Engine Test Equipment and Fixtures (Cont'd)

ITEM NO.	PART NO.	NOMENCLATURE	SUPPLIER
7.	Megger Model MJ10	Insulation Tester	AVO International (USA/Caribbean/Latin America/Asia Pacific) 4651 South Westmoreland Road Dallas, TX 75237-1017 USA TEL: 1-(800) 723-2861 (USA) 1-(214) 331-7363 FAX: 1-(214) 333-3533 (USA) 1-(214) 337-3038 or, AVO International (Canada) 110 Milner Avenue, Unit 1 Scarborough, Ontario Canada M1S 3R2 TEL: (800) 567-0286 FAX: (416) 298-0848 or, AVO International (U.K./Europe/Middle East/Southern Asia) archcliffe Road Dover, Kent CT17 9EN England TEL: 01 304 502101 FAX: 01 304 207342
8.	Model 8842A	Continuity Tester	Fluke Electronics Canada Inc 400 Britannia Road, Unit 1 Mississauga, Ontario Canada L4Z 1X9 TEL: (905) 890-7600 1-800-363-5853 FAX: (905) 890-6866 E-mail: canada@pc.fluke.com
9.	H337N	Test Set, engine performance, on-wing	Howell Instruments Corporation 3479 West Vickery Blvd Fort Worth, TX 76107 USA TEL: (817) 336-7411 FAX: (817) 336-7874 E-mail: howellinst.com

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TABLE 16, Engine Test Equipment and Fixtures (Cont'd)

ITEM NO.	PART NO.	NOMENCLATURE	SUPPLIER
10.	Kit, ACES Collector Analyzer Plus Model 1700 P/N Z1700-110V or -220V	Engine Vibration Measurement; comprises items 11. through 29.	TEC Aviation Division 10737 Lexington Drive P.O. Box 22996 Knoxville, TN 37933-0996 USA TEL: (615) 966-5856 FAX: (615) 675-1241
11.	ACES Collector Analyzer Plus Model 1700 P/N 10-100-0464	Engine Vibration Analysis	see item 10.
12.	4 MB Memory Expansion P/N 10-100-1337	Memory expansion for ACES Model 1700	see item 10.
13.	ACES JT15D RAM Procedure Card Version 1.11 or later P/N 75-200-001	Vibration analysis software	see item 10.
14.	ACES Phototach Optical Tachometer P/N 10-100-1773	Tachometer for measuring fan rpm	see item 10.
15.	ACES Lasetach Optical Tachometer P/N 10-100-1300	Tachometer for measuring fan rpm	see item 10.
16.	Tachometer Mounting Bracket P/N 22-430-0058	Nacelle bracket for Phototach tachometer	see item 10.
17.	Tachometer Mounting Bracket P/N 10-100-0196	Airframe bracket for Lasetach tachometer	see item 10.

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TABLE 16, Engine Test Equipment and Fixtures (Cont'd)

ITEM NO.	PART NO.	NOMENCLATURE	SUPPLIER
18.	Charge Converter, Model 530 P/N 10-100-0574	N1 and N2 rpm	see item 10.
19.	Speed Conditioning Unit (SCU), Model 517P P/N 10-100-0485	N1 and N2 rpm	see item 10.
20.	Velocity Sensor P/N 69-100-0016	Engine Plane 1 vibration	See item 10.
21.	Cable, High Temperature P/N 10-320-0008	Velocity Sensor-to-Charge Converter	See item 10.
20.	Cable P/N 10-320-0131	Charge Converter-to-Analyzer	See item 10.
21.	Cable, 50 ft. P/N 10-320-0126	Optical Probe-to-Speed Conditioning Unit	See item 10.
22.	Cable P/N 10-320-0180	COMM, SCU-to-Analyzer	See item 10.
23.	Cable P/N 10-320-0181	TACH, SCU-to-Analyzer	See item 10.
24.	Cable Assembly P/N 10-320-0178	N2 Rotational Speed	See item 10.
25.	Extension Cable P/N 10-320-0171	N2 Speed Cable-to-SCU	See item 10.
26.	Zthermal Printer	Portable Printer Kit	See item 10.

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TABLE 16, Engine Test Equipment and Fixtures (Cont'd)

ITEM NO.	PART NO.	NOMENCLATURE	SUPPLIER
26A.	Thermal Paper, Zthermal Printer P/N 75-900-0218	For Portable Printer	See item 10.
27.	Cable, Laptop/Printer Linking P/N 75-800-0020	Laptop Computer-to-Portable Printer	See item 10.
28.	Accessories Case P/N Z10-100-0403	ACES Analyzer Components	See item 10.
29.	Accessories Case P/N Z10-100-0404	ACES Analyzer Components	See item 10.
30.	N1 Tachometer Cable P/N 10-320-0169	N1 Rotational Speed	See item 10.
31.	N1 Tachometer Cable P/N 10-320-0179	N1 Speed Breakout Cable-to-SCU	See item 10.
31.	Balancer Analyzer No. 8500	Engine Vibration Measuring Device	Chadwick-Helmuth Company Inc. 4601 N. Arden Drive El Monte, CA USA TEL: (626) 575-6161 FAX: (626) 350-4236 E-mail: chadwick@chadwick-helmuth.com
32.	P/N 11130-1	Signal Selector/Switch Box	See item 31.
33.	P/N 7310	Velocimeter	See item 31.
34.	P/N 11210-50	Velocimeter Cable (50 ft)	See item 31.

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TABLE 16, Engine Test Equipment and Fixtures (Cont'd)

ITEM NO.	PART NO.	NOMENCLATURE	SUPPLIER
35.	P/N No. 6752	Velocimeter Mounting Bracket	See item 31.
36.	P/N No. 7194-1	Photoprobe Mounting Bracket	See item 31.
37.	P/N 10200-1	Photoprobe	See item 31.
38.	P/N 10185-50	Photoprobe Cable	See item 31.
39.	P/N 10170-1	Photocell Processor	See item 31.
40.	P/N 3140-9	dc Adapter Cable (312 bayonet bulb style)	See item 31.
41.	P/N 8998	Balancer Input Cable	See item 31.
42.	P/N 10811-12	Balancer to Signal Selector Cable (if signal selector is used)	See item 31.
43.	P/N 10813-12	Signal Selector Power Cable	See item 31.
44.	P/N 10055	JT15D-5 Fan Balance	See item 31.
45.	Borescope Inspection Kit	PWC34910-101	See Subpara. 1.B. for approved suppliers.
46.	35 MM Camera	PWC34960-201	See Subpara. 1.B. for approved suppliers.

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CONSUMABLE MATERIALS

1. Consumable Materials

A. General

Table 1 lists Consumable Materials required to maintain the engine. The table gives a complete list of all the consumable materials that are shown in each section of the manual. Consumable materials are fuels, oils, greases, lubricants, hydraulic fluids, sealants, adhesives and paints. Materials such as bolts, washers, nuts and packings are not included in the table. These materials are given in the Illustrated Parts Catalogs (IPC).

The term Consumable Material shall be defined as an expendable substance which is separately obtained from Pratt & Whitney Canada and which may be applied to the engine or its parts during maintenance. Refer to Table 1.

This manual describes processes that may require the use of chemicals, solvents, paints or other commercially available materials.

In many instances, products such as cleaning materials, are mentioned by their trade names to assist the operator in identifying the product types. These names are representative examples only and their inclusion does not necessarily exclude the use of other equivalent products.

Specification numbers applying to consumable materials are basic numbers and shall be interpreted to include all revisions and amendments thereto.

Material Safety Data Sheets (MSDS) containing information about Trade Name, Safety Hazards, Health Hazards, Reactivity, Spill or Leak Procedures, Special Protection Information, Special Precautions, and Transportation and Labelling are available from the manufacturer of the products. Read the data sheets prior to using the consumable materials.

The names of any companies provided in this publication as a possible source for required services or supplies are furnished for information purposes only. Pratt & Whitney Canada does not endorse the work performed or supplies procured from these companies. Further, Pratt & Whitney Canada does not accept responsibility, to any degree, for the selection of such companies for such work performed or supplies procured. Refer to Table 2.

B. Consumable Material Table

The consumable material table is divided into four columns as follows:

(1) Item No.

The item number given for the material is in this column. The number includes a PWC prefix to identify Pratt & Whitney Canada, a two-digit number to identify the type of material and a three-digit number to identify the material (eg: PWC03-001).

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Alternative materials are included if they are known and they have a letter added after the basic item number (eg: PWC03-001A). You can use these alternative materials unless differently specified in the manual. If the alternative material item number is identified in the manual, you must use the alternative material only. If you must use the basic item number material, an asterisk is shown after the number (eg: PWC03-001*).

The consumable materials are put into groups as follows:

- PWC01 - Fuels
- PWC02 - Hydraulic Fluids
- PWC03 - Oils
- PWC04 - Greases
- PWC05 - Special Materials
- PWC06 - Lubricants
- PWC07 - Lacquers
- PWC08 - Bonding and Adhesive Compounds
- PWC09 - Sealants
- PWC10 - Anti-icing and Materials to remove ice
- PWC11 - Cleaning Agents
- PWC12 - Strippers
- PWC13 - Preparation for Painting
- PWC14 - Disinfectants
- PWC15 - Storage Preservation
- PWC16 - Structure Paints
- PWC17 - Materials for the protection against Bacteriological Contamination

(2) Material

All materials are identified by their technical names (eg: oil, adhesive, anti-seize compound, abrasive cloths).

(3) Manufacturer's Specification/Reference

Trade names, specifications and standards that have a relation to the material are given in this column. Products which you can get from more than one source with a generic name (eg: Alcohol, Isopropyl) have the product reference identified as OPEN.

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(4) Supplier Code

Codes given in this column are the Manufacturer's Commercial Agency of Government Entity (CAGE) number. A supplier used by Pratt & Whitney Canada (P&WC) and Pratt and Whitney America (PWA), who does not have a CAGE No., is given a SXXXX code by PWA. A supplier used only by P&WC, who does not have a CAGE No., is given an AXXXX code by P&WC.

2. Consumable Materials

WARNING: REFER TO THE MANUFACTURER'S MATERIAL SAFETY DATA SHEETS FOR CONSUMABLE MATERIALS INFORMATION SUCH AS: HAZARDOUS INGREDIENTS, PHYSICAL/CHEMICAL CHARACTERISTICS, FIRE, EXPLOSION, REACTIVITY, HEALTH HAZARD DATA, PRECAUTIONS FOR SAFE HANDLING, USE AND CONTROL MEASURES.

A. Supplier Codes

The codes given are the Manufacturer's Commercial Agency of Government Entity (CAGE) number. A supplier used by Pratt & Whitney Canada (P&WC) and Pratt and Whitney America (PWA), who does not have a CAGE No., is given a SXXXX code by PWA. A supplier used only by P&WC, who does not have a CAGE No., is given a AXXXX code by P&WC.

TABLE 1, Consumable Materials

WARNING: READ MATERIAL SAFETY DATA SHEETS BEFORE USING THESE PRODUCTS.

Item No.	Material	Specification and/or Manufacturer's Reference	Supplier Code
PWC01-001	Fuel, Engine	SB7144	A0001
PWC03-001	Oil, Engine Lubricating	SB7001	A0001
PWC03-001D	Oil, Engine Lubricating	Castrol 5000	A0029 0EG91 37995
PWC04-001	Grease, Synthetic General Purpose	Ref. Open US. MIL-G-23827 QPL-23827-18 NATO G-354 PMC 79671	A0001
PWC04-003	Grease, Synthetic		A0001 A0030
PWC04-004	Grease, High Temperature	Plastilube No.3 PMC79919	77163 A0022 1V074

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TABLE 1, Consumable Materials (Cont'd)

WARNING: READ MATERIAL SAFETY DATA SHEETS BEFORE USING THESE PRODUCTS.

Item No.	Material	Specification and/or Manufacturer's Reference	Supplier Code
PWC04-005	Grease, Extreme Pressure	Lubriplate 130A PMC 79919	73219 A0032 A0033 A0034 A0035
PWC05-002	Layout Dye	Micro Supreme 142 Purple PMC4062	01058
PWC05-004	Hydrofluoric Acid Technical Grade	Open US. O-H-795 PMC1010	A0001 36842
PWC05-005A	Emulsifier	Witconate P10-59B	36382 85665
PWC05-006	Phosphoric Acid (Concentrated)	Open PMC1018	A0001 36842
PWC05-007	Fluid, Leak Checking	Leak Tec 372 PMC 9569	03530
PWC05-009	Ammonium Bifluoride	Crystalline	A0001
PWC05-018	Crayon, Metal Marking (Hard)	Design Spectracolor Silver 1428 PMC 4094	22980
PWC05-019	Compound, Lapping	Clover 2A US. MIL-L-17862 PMC3002	73165
PWC05-027	Ink	Carter 21451 Black	S0089
PWC05-037	Enamel Aluminized Epoxy	Desoto Super-Koropon 529K002 Base + 910K021 Curing Solution PMC 1746, PMC 1747 PWA569	A0097 S0098 ONYS9
PWC05-038	Hydrogen Peroxide	Open US. MIL-M-37730 PMC1602	A0001 08338
PWC05-041	Layout Dye	Dykem Steel Blue PMC 74002	98148

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TABLE 1, Consumable Materials (Cont'd)

WARNING: READ MATERIAL SAFETY DATA SHEETS BEFORE USING THESE PRODUCTS.

Item No.	Material	Specification and/or Manufacturer's Reference	Supplier Code
PWC05-046	Ink Marker	Instant Dry	A0013
PWC05-046A	Ink Marker	Fast Drying No.57 400-1 Black 400-2 Red 400-7 Purple	S0036
PWC05-046B	Ink Marker	Volger's Opaque Black	88597
PWC05-046C	Ink Marker	Dykem KX425 Dykem KXX122	98148
PWC05-048	Marker Pen	Brushpen No.57	S0036
PWC05-048A	Marker Pen	Felt Wick Pen	A0013 30133
PWC05-048B	Pen Marker	Marks-A-Lot Pen	03042
PWC05-049	Masking Material	Brady Mask PMC 74110	A0026
PWC05-050	Nitrogen, Technical Grade 99% Min. Purity	OPEN U.S. BB-N-411C PMC2212	A0001 0BZD7 09563
PWC05-052	Sheathing, Heat-shrinkable Silicone Rubber	1 Inch Dia. (25.4 mm)	A0001 06090
PWC05-056	Sodium Hydroxide (Caustic Soda) Commercial Grade	Open US. O-S-598B NaOH 95% Min. Chloride as NaCl 0.5% Max.	A0001
PWC05-058	Solder, Tin-Alloy	Ref. 50/50 MixUS. ANSI J-STD-004 ANSI J -STD-005 ANSI J -STD-006	09185 10178
PWC05-061	Cloth, Abrasive Coated, Crocus	Open US. Fed. A-A-1206	A0001
PWC05-063	Strapping Steel	Open US. ASTM D3953 Type 1, Class A, 0.70 in. Wide 0.023 in. Thick	A0001

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TABLE 1, Consumable Materials (Cont'd)

WARNING: READ MATERIAL SAFETY DATA SHEETS BEFORE USING THESE PRODUCTS.

Item No.	Material	Specification and/or Manufacturer's Reference	Supplier Code
PWC05-068	Masking Tape	Tuck Tape 101 PMC 4008	A0001 22473
PWC05-070	Tape, Pressure Sensitive Adhesive, Filament Reinforced	3M No. 898 Type II, 2 inch. US. PPP-T-97D	A0001 A0083 76381
PWC05-074	Sulfuric Acid Commercial or Technical Grade (Concentrated)	Open 66 Degrees Baume PMC1003	A1001
PWC05-077	Oil, Preservative	Grade 1010 Brayco 460 US. MIL-L-6081	A0001
PWC05-089	Lockwire or Safetywire (CRES)	MS9226-03 US. AMS 5687 (0.025 in.) (0.635 mm)	A0001 8W577
PWC05-100	Stone, Flexible Abrasive	OPEN US MIL-S-17364	A0001 44197 61158
PWC05-101	Cloth, Abrasive (Aluminum Oxide or Silicon Carbide)	OPEN US ANIS B74018 No. 320 Grit	A0001 44197 61158
PWC05-103	(Surface Marking)	Phano No. 71 Red	70362
PWC05-110	Lockwire or Safetywire (CRES)	MS 9226-01 US. AMS 5687 (0.016 in.) (0.406 mm)	A0001
PWC05-128	Compound, Lapping Silicon Carbide	Ref. Clover A 280 Grain Size PMC 3011	73165
PWC05-144	Abrasive Wheel	1/8 inch X 2 inches A54IBF	45586
PWC05-145	Lapping Compound	Clover 2A No. 400 Grit PMC 3013	73165
PWC05-147	Electrode, 2% Thoriated Tungsten	Open PMC5052-3 Length: 7 inch Diameter: 1/16 inch	A0001 05838 28835

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TABLE 1, Consumable Materials (Cont'd)

WARNING: READ MATERIAL SAFETY DATA SHEETS BEFORE USING THESE PRODUCTS.

Item No.	Material	Specification and/or Manufacturer's Reference	Supplier Code
PWC05-151	Filler Wire, Welding	Open US. AMS 5837	A0001 OHJT8 2R602
PWC05-157	Oil, Turbine Engine Corrosion Preventative	PWA540	A0001 29700
PWC05-158	Open Steel Sheet, Corrosion and Heat Resis-tant	AMS5504	A0001
PWC05-159	Open Steel Sheet, Nickel-based, (Hastalloy)	AMS5536	A0001 8W577
PWC05-171	Emulsifier, Crack Detection	Zyglo ZE-4B	A0001 37676
PWC05-172	Penetrant, Fluorescent Water Washable (Normal Sensitivity; Level 2)	Magnaflux ZL-60D PMC 4351-2	A0001 37676
PWC05-173	Penetrant, Fluorescent Water Washable (High Sensitivity	Magnaflux ZL-67 PMC 4360-2	A0001 37676
PWC05-174	Penetrant, Fluorescent Non-Water Washable (High Sensitivity; Level 3) Post-emulsified	Magnaflux ZL-27A PMC 4353-2	A0001 37676
PWC05-175	Dry Developer Fluorescent-Penetrant	Magnalflux ZP-4B PMC4356	A0001 37676
PWC05-177	Demineralizer Cartridge	9-035-20	A0001 22527 95059
PWC05-178	Marker Pen	Cado Marker	A0001 A0067 75554

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TABLE 1, Consumable Materials (Cont'd)

WARNING: READ MATERIAL SAFETY DATA SHEETS BEFORE USING THESE PRODUCTS.

Item No.	Material	Specification and/or Manufacturer's Reference	Supplier Code
PWC05-180	Filler Wire, Welding	Open Hastelloy X AMS5798	A0001 OHJT8 2R602
PWC05-195	Acid, Nitric Commercial Grade	Open US. O-A-88 O-N-350B 5 o 10% Solution 42% Reagent Grade 45 Degrees Baume PMC 1000	A0001
PWC05-196	Acid, Hydrochloric or Muriatic Technical Grade	Open US. O-H-765 MIL-H-13528A 37 % Reagent Grade 20 Degrees Baume PMC 1002	A0001 85394
PWC05-197	Acid , Chromic Flakes or Commercial Grade Solution	Open US. O.C-303 CrO3 - 99.5% Min. SO4 - 0.020% Max. PMC 1001	A1001
PWC05-215	Filler Wire, Welding	Ref. 51410 US AMS 5776 (0.035 in.)	A0001 OHJT8 2R602
PWC05-238	Projection Material, High Gain, Front	3M Product No. 7610 1/2 inch	A0077 A0082 26066
PWC05-256	Enhancer, Electrical Contact	Stabilant 22	38948
PWC05-257	Reflective Patches	Part No. 3300	99866
PWC06-002	Petrolatum, White	Ref. Open Technical Grade US. Fed. AN-P-51 PMC 9609	A0001 86459

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TABLE 1, Consumable Materials (Cont'd)

WARNING: READ MATERIAL SAFETY DATA SHEETS BEFORE USING THESE PRODUCTS.

Item No.	Material	Specification and/or Manufacturer's Reference	Supplier Code
PWC06-004	Compound, Anti-seize (Molybdenum Disulfide)	Dow Corning G-N Metal Assembly Paste US. MIL-M-7866 UK DEF STAN 80-81 NATO S-722 JSD ZX-38 PMC9549	A0018 71984
PWC06-004A (Molybdenum Disulfide)	Compound, Anti-seize	Dow Corning Z Moly Powder US. MIL-M-7866 UK DEF STAN 80-81 NATO S-722 JSD ZX-38 PMC9523 Dow Corning Z Moly Powder	A0018 71984
PWC06-005	Lubricant, Dry Spray	MS-122DF PMC79904-1 CPW310	A0103 1DD67 1E473 18598
PWC06-009	Compound, Anti-seize	NEVER-SEEZ Pure Nickel Special PWA36053 or PWC36053-1 PMC79966 (CPW 553)	5W425 75437
PWC06-032	Compound, Anti-galling & Anti-seize (High-Temperature)	Fel-Pro C-200 MIL-A-907 PWA 586 PMC 79912 CPW 37	73165
PWC06-032A	Compound, Anti-galling/ Anti-seize (High-Temperature)	Ease-off 990 US. MIL-A-907 PWA 586 PMC 79912	87889
PWC08-006	Adhesive, Epoxy, Flexible (Two part)	Scotchweld EC-2216B/A PMC79944 CPW525	76381
PWC08-009	Cement, Synthetic Ceramic	Sauereisen Filler No. 29 Sauereisen Binder No. 29 PWA 36004	A0071 80703

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TABLE 1, Consumable Materials (Cont'd)

WARNING: READ MATERIAL SAFETY DATA SHEETS BEFORE USING THESE PRODUCTS.

Item No.	Material	Specification and/or Manufacturer's Reference	Supplier Code
PWC09-001	Cement, Silastic Silicone Rubber Sealant	Silastic DC RTV732 CPW 519-11	D8367 K7750 71984
PWC09-001A	Cement, Silastic Silicone Rubber Sealant (RTV)	RTV 102, 103, 108 and 109	01139
PWC09-003	Compound, Silicone, Insulating and Sealing	Dow Corning No. 4 US. MIL-S-8660 PMC9926 (CPW326)	71984 D8367
PWC09-004A	Compound, Silicone, Sealing	Dow Corning DC 732 RTV PMC 1836 CPW 519-11	D8367 K7750 71984
PWC09-005	Compound, Universal Joining (Medium Grade)	ST 512 Hylomar SQ-32 CPW 267-3	A0014 A0112 S0116 K3237 60543
PWC09-005A	Compound, Universal Joining (Medium Grade)	Hylomar PL-32 PWA 36000-3	A0014 A0112 D1716 K3237 S0101 S0116 60543
PWC09-006	Compound, Universal Joining (Light Grade)	ST 512 CPW 267-4	A0014 A0112 K3237 S0116 60543
PWC09-006A	Compound, Universal Joining (Light Grade)	Hylomar PL-32 PWA 36000-4	A0014 A0112 D1716 K3237 S0101 S0116 60543
PWC09-012	Silicone Cement, Rubber, High Temperature	RTV 106	01139

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TABLE 1, Consumable Materials (Cont'd)

WARNING: READ MATERIAL SAFETY DATA SHEETS BEFORE USING THESE PRODUCTS.

Item No.	Material	Specification and/or Manufacturer's Reference	Supplier Code
PWC09-017A	Adhesive/Sealant, Silicone Rubber, Single Component Type (Room Temperature)	DC 736 RTV PMC71836 CPW519-12	71984
PWC09-022	Compound, Jointing, (Non-curing)	CA 1000 CPW 638	0NYS9(m)
PWC11-010	Methanol (Methyl Alcohol)	Open US. AMS 3004 O-M-232 Grade A PMC 9089	A0001
PWC11-012	Acetone	Ref. Open PMC 9008	A0001
PWC11-014	Alcohol, Isopropyl Technical Grade	Open US. TT-I-735 Grade A PMC 9094	A0001
PWC11-014B	Alcohol, Isopropyl Commercial Grade	Open #1449 Commercial Grade PMC 79003	A0001 36842
PWC11-016	Ref. Vapour Degreaser Grade Perchlorethylene Inhibited	US. O-T-236 PMC9015	A0001
PWC11-021	Compound, Carbon Remover (Cold)	Turco SuperCarb	0BYN5 36325
PWC11-022	Methyl Ethyl Ketone (MEK), Technical Grade	PMC9076 PMC79908 US TT-M-261	A0001 36842
PWC11-027	Petroleum Solvent	Open US. AMS 3160 P-D-680 Type II PMC 9010	A0001 36131
PWC11-031	Engine Cleaner	Tergit PMC 79783	35502
PWC11-035	Solvent, Cleaning, Electrical Contacts	LPS Electro-Contact Cleaner PMC 79019	A0001 66724

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TABLE 1, Consumable Materials (Cont'd)

WARNING: READ MATERIAL SAFETY DATA SHEETS BEFORE USING THESE PRODUCTS.

Item No.	Material	Specification and/or Manufacturer's Reference	Supplier Code
PWC11-036	Conditioner, Preservative, Electrical	Cramolin Pro Gold G5 & G5S PMC 79017	55403
PWC11-042	Cleaner	3M Citrus Base Cleaner (6 oz.)	A0077 76381
PWC11-056	Alkaline Carbon Remover	Turco 5805 SPMC 136	0BYN5 36325
PWC13-001	Primer, Epoxy	Primer Base: 519 X 303 + Curing Solution: 910-357 + Solvent: 020 X 324 PWA 568 (CPW 268)	A0097 S0098 ONYS9
PWC15-001	Dessicant Activated Silica Gel 12 Unit Bags	Open US. MIL-D-3464 Grade 1	A0001
PWC15-002	Indicator, Humidity	Ref. MS20003-2 Humi-Spot	96043
PWC15-011	Inhibitor, Engine Rust (External Engine Cold Section)	Corrosion-X US. MIL-C-81309	0VJ14 A0001(s)
PWC15-015	Compound, Corrosion Preventative (Water Displacing)	Ardrox 3961	37127

TABLE 2, Supplier Codes and Addresses

Supplier Code	Name/Address
A0001	Local Supply Local Purchase
A0004	Collier Chemical Co. Binghampton, NY USA

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TABLE 2, Supplier Codes and Addresses (Cont'd)

Supplier Code	Name/Address
A0013	Speedry Products Inc. Richmond Hill, NY USA TEL: Not available FAX: Not available
A0014	Kingsley and Keith Canada Ltd. 1010 de Sevigny, 7th Floor Longueuil, Quebec Canada J4K 5G7 TEL: (450) 442-4394 FAX: Not available
A0016	Marston Lubricants (see K3237)
A0018	National Bearings Ltd. 724 Renaud Dorval, Quebec Canada H9S 1H5 TEL: (514) 333-7000 FAX: Not available
A0022	Parr Industries 35 Oak Street Weston, Ontario Canada M9N 1R9 TEL: Not available FAX: Not available
A0026	W.H. Brady Inc. 10 Marmac Drive Rexdale, Ontario Canada M9W 1E6 TEL: (416) 675-7111 (800) 387-3917 FAX: Not available
A0029	Castrol (UK) Ltd. Burmah House , Pipers Way Swindon, Berkshire England SN3 1R3
A0030	Imperial Oil Canada 111 St. Clair Ave. W. Toronto, Ontario Canada M5W 1K3 TEL: (416) 968-4111 FAX: (416) 968-4374

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The export control classification with respect to this document is contained on the back of the title page.

TABLE 2, Supplier Codes and Addresses (Cont'd)

Supplier Code	Name/Address
A0032	Antwerp Marine Center, S.A. Mechelsctteenweg 43 B-2000 Antwerp Belgium TEL: 32-3-2320084 FAX: Not available
A0033	L.L. Ltd. 15 Russell Garden Mews London England W14 8EU TEL: Not available FAX: Not available
A0034	Kian Seng Hardware Trading Pts. Ltd. 168 Sims Ave. Singapore Singapore TEL: 14-3865-748-7144 FAX: Not available
A0035	F. Bacon & Co. Inc. Div. De Drummond-Sullivan Co. 274 Chemin Bates Montreal, Quebec Canada H3S 1A3 TEL: (514) 737-3755 FAX: Not available
A0041	Trafficair The Kent Chemical Co. Ltd. George House Bridgewell Lane Tenderden, Kent United Kingdom TN30 6HS
A0067	Cushman & Denison New York, NY USA TEL: Not available FAX: Not available
A0071	Corrosion Service Co. Ltd. 369 Rimrock Rd. Downsview, Ontario Canada M3J 3J2 TEL: (416) 630-2600 FAX: (416) 630-2393

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TABLE 2, Supplier Codes and Addresses (Cont'd)

Supplier Code	Name/Address
A0077	Cine Sound and Projection Inc. 258 Raleigh Ave. Scarborough, Ontario Canada M1K 1A8 TEL: 1-800-3M-HELPS FAX: Not available
A0082	Technology Energy Corporation 10737 Lexington Drive Knoxville, TN 37932 USA TEL: Not available FAX: Not available
A0083	3M Canada Inc. P.O. Box 5757 Oxford St. E. London, Ontario Canada N6A 4T1 TEL: (519) 451-2500 Telex: 064-5886 FAX: (519) 452-6262
A0097	Courtaulds Aerospace A Division of International Paints Canada Ltd. 5676 Timberlea Blvd. Mississauga, Ontario Canada L4W 4M6 TEL: (905) 629-7999 FAX: (905) 629-7009
A0103	Miller-Stephenson Chemical Co. Inc. 514 Carlingview Drive Rexdale, Ont. Canada M9W 5R3 TEL: (416) 675-3204 (800) 323-4621 FAX: (416) 674-2987 E-mail: www.miller-stephenson.com
A0112	Valco Cincinatti 411 Circle Freeway Drive Cincinnatti, OH 45246 USA TEL: (513) 874-6550 FAX: (513) 874-3612

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The export control classification with respect to this document is contained on the back of the title page.

TABLE 2, Supplier Codes and Addresses (Cont'd)

Supplier Code	Name/Address
D1716	Martson Oelchemie GmbH Bergheimer Strasse Postfach 5352 Zuelpich Germany TEL: Not available FAX: Not available
D8367	Dow Corning GmbH Schmierstoffe Pelkovenstrasse 152 , 8000 Muenchen 50 Germany TEL: Not available FAX: Not available
K3237	Marston Bentley Ltd. 9 Naylor Street Liverpool England L3 6DS TEL: Not available FAX: Not available
K7750	Dow Corning Ltd. Molykote Division NG Co. Avco House Castle Street Reading Berks RG1 7-Z United Kingdom TEL: Not Available FAX: Not Available
0HJT8	Airgas Northeast Inc. 325 McCausland Court Cheshire, CT 06410 USA TEL: (203) 250-6800 FAX: (203) 250-6834
S0011	Keough & Associates 210 Tumblebrook Road Meriden, CT 06450 USA
S0036	Texrite Products Co. 10333 Shoemaker St. Detroit, MI 48213 USA TEL: (313) 925-9002 FAX: (313) 925-9602

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The export control classification with respect to this document is contained on the back of the title page.

TABLE 2, Supplier Codes and Addresses (Cont'd)

Supplier Code	Name/Address
S0089	Avery Dennison Dennison Division One Clark Hill Farmington, MA 01701 USA TEL: (508) 879-0511 FAX: (508) 383-4259 or, Office Products Canada 200 Base Line Road East Bowmanville, Ont Canada L1C 1A2 TEL: (905) 623-6311 FAX: (905) 623-9751
S0098	ASC Philadelphia (A distributor of Courtaulds Aerospace) 823 East Gate Mt. Laurel, NJ 08054 USA TEL: (609) 234-1600 FAX: (609) 234-5515
S0101	Power in Motion 16A Montesano Road Fairfield, NJ 07004 USA TEL: (201) 244-0101 FAX: (201) 244-0760
S0116	W. Canning Inc. 223 North Brockman St. Pasadena, TX 77506 USA TEL: (713) 472-5081 (800) 521-2589 FAX: (713) 472-2440

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TABLE 2, Supplier Codes and Addresses (Cont'd)

Supplier Code	Name/Address
0BYN5	Turco Products Inc. Sub. of Elf Atochem North America 7300 Bolsa Avenue Westminster, CA 92684-3600 USA TEL: (714) 890-3600 FAX: (714) 892-7179 or, Turco Products Inc. Sub. of Elf Atochem North America 2700 Temple Avenue, Suite B Long Beach, CA 90806 USA TEL: (562) 981-8300 FAX: Not available
0BZD7	Liquid Air Engineering Corp. 1155 Sherbrooke St. W. Montreal, Quebec Canada H3A 1H8 TEL: (514) 842-5431 FAX: Not available
0EG91	Castrol Inc. Raritan Plz. 2 Fieldcrest Avenue Edison, NJ 08817 USA TEL: (201) 225-6390 FAX: Not available
OHJT8	Airgas Northeast Inc. 325 McCausland Court Cheshire, CT 06410 USA TEL: (203) 250-6800 FAX: (203) 250-6834
0NOL1	Trafficair Inc. 200 Technology Drive Alpharetta, GA 30201 USA
0NYS5	PRC-Desoto International 5430 San Fernando Road Glendale, CA 91203 USA TEL: (818) 240-2060 FAX: (818) 549-7595

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The export control classification with respect to this document is contained on the back of the title page.

TABLE 2, Supplier Codes and Addresses (Cont'd)

Supplier Code	Name/Address
0NYS9(m)	(See 83574)
0VJ14	CorrosionTechnologies Corp. 2638 National Drive 30201 USA, TX 30201 USA TEL: (972) 271-7361 FAX: (972) 278-9721 Website: www.corrosionx.com
01139(A)	General Electric Co. Attn: Rubber and Fluid Products Dept. Attn: Customer Support 260 Hudson River Road Waterford, NY 12188 USA TEL: (518) 233-3330 (800) 255-8886 FAX: Not available
01058	Michigan Chrome & Chemical Co. 8615 Grinnel Ave. Detroit, MI 48213-1152 USA TEL: (313) 267-5279 FAX: Not available
01139(B)	General Electric Co. Attn: Silicone Sales Dept. Attn: Customer Support 260 Hudson River Road Waterford, NY 12188 USA TEL: (518) 233-3330 (800) 255-8886 FAX: (518) 233-3931
03042	See S0089
03530	American Gas & Chemicals Co. Ltd. 220 Pegasus Ave. Northvale, NJ 07647-1904 USA TEL: (201) 767-7300 (800) 288-3647 FAX: (201) 767-1741 E-mail: agc@amgas.com

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The export control classification with respect to this document is contained on the back of the title page.

TABLE 2, Supplier Codes and Addresses (Cont'd)

Supplier Code	Name/Address
05838	Philips Elmet Corp. 1560 Lisbon Road Lewiston, ME 04240 USA TEL: (207) 784-3591 (800) 526-7480 FAX: Not available
06090	Raychem Corp. Electronic Systems Group 300 Constitution Drive Menlo Park, CA 94025-1111 USA TEL: (650) 361-3333 FAX: (650) 361-2441
08338	Allied Chemicals Canada Ltd. Fluorine Products 201 City Centre Dr. Mississauga, Ontario Canada L5B 2T4 TEL: (905) 276-9211 FAX: (905) 276-5711
09185	Litton Industries Kester Solder Division 515 E. Touhy Ave. Des Plaines, IL 60018-2675 USA TEL: (847) 297-1600 (800) 253-7837 FAX: (847) 390-9338 (847) 699-5548 E-mail: customerservice@kester.com
09563	Liquid Carbonic Canada Ltd 255 Brimley Rd. Toronto, Ontario Canada M1M 3J2 TEL: (416) 266-3161 FAX: (416) 266-0639

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The export control classification with respect to this document is contained on the back of the title page.

TABLE 2, Supplier Codes and Addresses (Cont'd)

Supplier Code	Name/Address
1DD67	Miller-Stephenson Chemical Co. Inc. 6348 Oakton Street Morton Grove, IL 60053 USA TEL: (847) 966-2022 (800) 992-2424 FAX: (847) 966-8468 E-mail: www.miller-stephenson.com
1E473	Miller-Stephenson Chemical Co. Inc. 12261 Foothill Boulevard Sylamar, CA 91342 USA TEL: (818) 896-4714 (800) 992-2424 FAX: (818) 896-6086 E-mail: www.miller-stephenson.com
1VO74	Sulfo Inc. 1158 Erie Ave. P.O. Box 285 North Tonawanda, NY 14120-3507 USA TEL: (716) 695-3585 FAX: (716) 695-0367
10178	Kester Solder Co. of Canada Ltd. 1 Prince Charles Road P.O. Box 474 Brantford, Ontario Canada N3T 5N9 TEL: (519) 753-3425 FAX: (519) 753-0641
18598	Miller-Stephenson Chemical Co. Inc. George Washington Highway P.O. Box 905 Danbury, CT 06813 USA TEL: (203) 743-4447 (800) 992-2424 FAX: (203) 791-8702 E-mail: www.miller-stephenson.com

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The export control classification with respect to this document is contained on the back of the title page.

TABLE 2, Supplier Codes and Addresses (Cont'd)

Supplier Code	Name/Address
2F245	Purex Corp. 24600 S. Main St. P.O. Box 6200 Carson, CA USA 90749
2R128	Castrol Inc. Speciality Products Division Suite 230 16715 Van Karman Avenue Irvine, CA 92714 USA TEL: (714) 660-9414 (800) 458-5823, Ext. 3012 FAX: Not available
2R602	Astrolite Alloys Division of Astro Metallurgical 709 Via Alondra Camarillo, CA 93010-8714 USA TEL: (800) 235-5935 (805) 484-3621 FAX: (805) 388-0577
22473	Canadian Technical Tape Ltd. 455 Cote Vertu Montreal, Quebec Canada H4N 1E8 TEL: (514) 334-1510 Telex: 05-826634 FAX: (514) 745-0764
22527	Fisher Scientific Co. 585 Alpha Drive Pittsburgh, PA 15238-2911 USA TEL: (412) 963-3300 FAX: (412) 963-3329
22980	Fisher Scientific Co. 585 Alpha Drive Pittsburgh, PA 15238-2911 USA TEL: (412) 963-3300 FAX: (412) 963-3329

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The export control classification with respect to this document is contained on the back of the title page.

TABLE 2, Supplier Codes and Addresses (Cont'd)

Supplier Code	Name/Address
26066	Minnesota Mining & Mfg. Co. 3M Company Tapes & Specialties Div. 3M Center St. Paul, MN USA 55144-1000
28112	Minnesota Mining & Mfg. Co. 3M Company Industrial Chemical Products 3M Center St. St. Paul, MN 55144 -1000 USA TEL: (800) 364-3577 FAX: (612) 737-7117
28835	Hobart Bros. Co. Hobart Square 600 W. Main Street Troy, OH 45373 USA TEL: (937) 332-4000 FAX: (937) 332-4090
29700	Exxon Co. USA Aviation Sales P.O. Box 4803 Houston, TX 77210-4803 USA TEL: (713) 656-3636 (800) 443-9966 FAX: (713) 656-5301
30133	Ideal Stencil Machine and Tape 102 Iowa Ave. P.O. Box 305 Belleville, IL 62222-0305 USA TEL: (618) 233-0162 FAX: Not available
32988	Faber Castell Corp. 551 Spring Place Road P.O. Box 330 Lewisburg, TN USA 37091-3447

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE 2, Supplier Codes and Addresses (Cont'd)

Supplier Code	Name/Address
35502	Magnus Chemical Ltd. (MAG - CHEM INC.) 190 Blvd. Industriel Boucherville, Quebec Canada J4B 2X3 TEL: (450) 655-1344 FAX: (450) 655-5428
36131	Shell Canada Products Limited 400 4th Ave. SW P.O. Box 100 Station M Calgary, Alberta Canada T2P 2H5 TEL: (403) 691-3111 FAX: (403) 691-3777
36325	Deane & Co. Div. of Groulx-Robertson Ltee/Ltd. 190 Oneida Drive Pointe Claire, Quebec Canada H9R 1A8 TEL: (514) 697-3730 FAX: (514) 697-3887
36382	Witco Canada 565 Coronation Drive West Hill, Ontario Canada M1E 2K3 TEL: (416) 724-3605 FAX: (416) 284-4316
36842	Anachemia Canada Inc. 500 2nd Ave. Ville St. Pierre, Quebec Canada H8R 1M3 TEL: (514) 489-5711 FAX: (514) 363-5281
37127	Brent Canada Ltd. 363 Arvin Ave. Stoney Creek, Ontario Canada L8E 2M8 TEL: (905) 662-8046 FAX: (905) 662-5966

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The export control classification with respect to this document is contained on the back of the title page.

TABLE 2, Supplier Codes and Addresses (Cont'd)

Supplier Code	Name/Address
37676	Magnaflux Corp. 3624 W. Lake Ave. Glenview, IL 60025 USA TEL: (847) 657-5300 FAX: (847) 657-5388
37995	Castrol Canada Inc. 3660 Lakeshore Blvd West Box 3, Stn. N Toronto, Ontario Canada M8W 1P2 TEL: (416) 252-5511 FAX: (416) 252-0703 or, Castrol Canada Inc. 2149 Winston Park Dr. Oakville, Ontario Canada L6H 5R1 TEL: (905) 829-2300 Tlx: 06984515 FAX: Not available
38948	D.W. Electrochemicals Ltd. 97 Newkirk Road North Richmond Hill, Ontario Canada L4C 3G4 TEL: (905) 508-7500 FAX: (905) 508-7502
44197	Norton Co. (Export Sales) 1 New Bond Street P.O. Box 15008 Worchester, MA 01606-0008 USA TEL: (508) 795-5307 (800) 446-1119 FAX: (508) 795-4130
45586	Pangborn Co. A Kennecott Co. 10 Pangborn Blvd. Box 380, Dept. 20 Hagerstown, MD 21740-0380 USA TEL: (301) 739-3500 FAX: (215) 672-4805

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The export control classification with respect to this document is contained on the back of the title page.

TABLE 2, Supplier Codes and Addresses (Cont'd)

Supplier Code	Name/Address
5W425	Bostik Inc. 211 Boston Street Middleton, MA 01949-2128 USA TEL: (978) 777-0100 FAX: (978) 750-7212 E-mail: www.bostik.com
55403	Caig Laboratories Inc. 12200 Thatcher Court Ponway, CA 92064 USA TEL: (619) 486-8388 FAX: (619) 486-8398
58913	Sermatech International Inc. Materials Division 155 South Limerick Road Limerick, PA 19468-1603 USA TEL: (610) 948-5100 FAX: (610) 948-5407
60543	Ryder-Aviall 2075 Diplomat P.O. Box 7086 Dallas, TX 75234 USA TEL: (214) 406-2000 FAX: Not available
61102	(see 0BYN5)
61158	Unifrax Corp. (The Carborundum Co.) 2351 Whirlpool St. Niagara Falls, NY 14305-2413 USA TEL: (716) 278-3827 Canada: (800) 635-4464 FAX: (716) 278-3904 E-mail: www.unifrax.com

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE 2, Supplier Codes and Addresses (Cont'd)

Supplier Code	Name/Address
66724	LPS Laboratories Division of Holt Lloyd Corp. P.O. Box 105052 4647 Hugh Howell Road Tucker, GA 30084-5052 USA TEL: (800) 241-8334 FAX: (770) 493-9206 E-mail: lpslabs@ix.netcom.com
70362	Dixon Ticonderoga Co. Sandusky Division. 1706 Hayes Avenue P.O Box 2258 Sandusky, OH 44870-4732 USA TEL: (800) 824-9430 (419) 625-9545 FAX: (419) 625-0719
71984	Dow Corning Corp. 2200 West Salzburg Rd. P.O. Box 994 Midland, MI 48686-0994 USA TEL: (517) 496-6000 (800) 248-2481 FAX: (517) 496-6974 or, Dow Corning Canada Inc. 189 Hymus Blvd. Suite No. 505 Pointe Claire, Que. Canada H9R 1E9 TEL: (514) 694-0089 (800) 663-4300 FAX: (514) 694-0632 (800) 561-0650
73165	Fel-Pro Inc. Div. of Felt Products Mfg. Co. 7450 North McCormick Blvd. P.O. Box 1103 Skokie, IL 60076-8103 USA TEL: (847) 674-7700 (800) 323-4356 FAX: (847) 674-0019

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The export control classification with respect to this document is contained on the back of the title page.

TABLE 2, Supplier Codes and Addresses (Cont'd)

Supplier Code	Name/Address
73219	Fiske Brothers Refining Co. 129 Lockwood St. Newark, NJ 07105-4720 USA TEL: (973) 589-9150 FAX: (973) 589-4432
75437	EOE, Inc. 585 Fourth Street P.O. Box 177 Troy, NY 12181 USA TEL: (518) 272-6922 FAX: (518) 272-2182
75554	Jackson Lea A Unit of Jackson Inc. 75 Progress Lane P.O. Box 71 Waterbury, CT 06705 USA TEL: (203) 753-5118 FAX: (203) 754-3770 or Jackson Lea A Unit of Jackson Inc. 1701 Highway 70 East Conover, NC 28613 USA TEL: Not available FAX: Not available
76381	3M Company 3M Center St. Paul, MN 55144-1000 USA TEL: (612) 737-6501 (800) 364-3577 FAX: (612) 737-7117
77163	See 1V074
8W577	Aerospace Specifications Metals 1384 W. McNab Rd. Ft. Lauderdale, FL 33309 USA TEL: (954) 977-0666 FAX: (954) 977-3858

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE 2, Supplier Codes and Addresses (Cont'd)

Supplier Code	Name/Address
80703	Saureisen Cements Co. 160 Gamma Drive Pittsburgh, PA 15238-2920 USA TEL: (412) 963-0303 FAX: (412) 963-7620
83574(m)	PRC-Desoto International (formally Courtaulds Aerospace, Inc.) 5430 San Fernando Road Glendale, CA 91209 USA TEL: (818) 549-7973 FAX: (818) 549-7595 Website: www.ppg.com/prc-desoto
85394	Berg Chemical Co. 920 E. 132nd Street Bronx, NY 10019 USA
85570	See 0NYS9
85665	Witco Corp. 1 American Lane Greenwich, CT 06831-2559 USA TEL: 1-888-544-3199 FAX: (203) 552-2850
86459	Penreco 138 Petrolia St. Karns City, PA 16041 USA TEL: (800) 245-3952 FAX: (724) 756-1050
87889	The Texacone Co. 4111 Forney Road Mesquite, TX 75149-2722 USA TEL: (800) 235-2727 FAX: Not available

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE 2, Supplier Codes and Addresses (Cont'd)

Supplier Code	Name/Address
88597	Volger Mfg. Co. 82 Fulton Street Elizabeth, NJ 07206 USA TEL: Not available FAX: Not available
95059	Fisher Scientific Co. 8505 Devonshire Road P.O. Box 6083, Sta. A Montreal, Quebec Canada H4P 2L4 TEL: (514) 342-5001 FAX: Not available
96043	Driaire 26 Fitch St. P.O. Box 569 South Norwalk, CT USA TEL: Not available FAX: Not available
98148	Dykem Co. 3624 West Lake Ave. Glenview, IL 60025 USA TEL: (800) 323-9538 FAX: (800) 323-9536
99742	Permacel Div. of Nitto Penko America P.O. Box 671 U.S. Highway No. 1 New Brunswick, NJ 08903 USA TEL: (732) 418-2400 Telex: 6858014 PERMACEL FAX: (732) 418-2739
99866	Chadwick-Helmuth Company Inc. 4601 N. Arden Drive El Monte, CA USA TEL: (626) 575-6161 FAX: (626) 350-4236 E-mail: chadwick@chadwick-helmuth.com

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The export control classification with respect to this document is contained on the back of the title page.

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
LEP	1	May 13/2013
	2 blank	May 13/2013
Contents	1	May 13/2013
	2 blank	May 13/2013
Airworthiness Limitations	1	May 13/2013
	2	May 13/2013

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The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT PAGE

AIRWORTHINESS LIMITATIONS

1. General 2

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AIRWORTHINESS LIMITATIONS

The Airworthiness Limitations section is FAA approved and specifies maintenance required under Sections 43.16 and 91.403 of title 14 of the Code of Federal Aviation Regulations unless an alternative program has been FAA approved.

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1. General

The Airworthiness Limitations section specifies mandatory Rotor Component Service Life Limits required for type certification. The Airworthiness Limitations section is approved by the Canadian Minister of Transport and specifies maintenance required by any applicable airworthiness or operational rule unless an alternative program has been approved by the Canadian Minister of Transport.

For Rotor Component Service Life Limits refer to the latest revision of Service Bulletin 7002.

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The export control classification with respect to this document is contained on the back of the title page.

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
LEP	1	Oct 31/2003
	2 blank	Oct 31/2003
Contents	1	Oct 31/2003
	2	Oct 31/2003
	3	Oct 31/2003
	4	Oct 31/2003
	5	Oct 31/2003
	6 blank	Oct 31/2003
70-00-00 Maintenance Practices	201	Jul 05/2002
	202	Jul 05/2002
	203	Jul 05/2002
	204	Jul 05/2002
	205	Jul 05/2002
	206	Jul 05/2002
	207	Jul 05/2002
	208	Jul 05/2002
	209	Jul 05/2002
	210	Jul 05/2002
	211	Jul 05/2002
	212	Jul 05/2002
	213	Jul 05/2002
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	224	Jul 05/2002
	225	Jul 05/2002
	226	Jul 05/2002
	227	Jul 05/2002
	228	Jul 05/2002
	229	Jul 05/2002
	230	Jul 05/2002
	231	Jul 05/2002
	232	Jul 05/2002
	233	Jul 05/2002
	234	Jul 05/2002
	235	Jul 05/2002
	236	Jul 05/2002
70-00-00 Removal/ Installation	401	Sep 29/2000
	402	Sep 29/2000
	403	Sep 29/2000
	404	Sep 29/2000
	405	Sep 29/2000
	406	Sep 29/2000
70-00-00 Inspection Check	601	Oct 22/99
	602	Oct 22/99
	603	Oct 22/99
	604	Oct 22/99
	605	Oct 22/99
	606	Oct 22/99
	607	Oct 22/99
	608	Oct 22/99
	609	Oct 22/99
	610 blank	Oct 22/99
70-00-00 Cleaning/ Painting	701	Oct 22/99
	702	Oct 22/99
70-00-00 Approved Repairs	801	Oct 31/2003
	802	Oct 31/2003
	803	Oct 31/2003
	804	Oct 31/2003
	805	Oct 31/2003
	806	Oct 31/2003
	807	Oct 31/2003
	808	Oct 31/2003
	809	Oct 31/2003
	810 blank	Oct 31/2003

TABLE OF CONTENTS

SUBJECT	PAGE
STANDARD PRACTICES - MAINTENANCE PROCEDURES	**70-00-00**
1. General	201
2. Consumable Materials	201
3. Special Tools	202
4. Fixtures, Equipment and Supplier Tools	202
5. General	202
6. Special Limits and Torque Recommendations	203
A. General	203
B. Terms and Symbols	203
7. Standard Torques	204
A. Torque Limit Values	204
B. Lubricants	204
C. Tightening Procedures	205
D. Torque Check For Reuse Of Self-Locking Fasteners	205
8. Torque Indicating Devices	206
A. General	206
B. Torque Wrench and Extensions	206
9. Torque Recommendations	208
A. General	208
B. Antiseize Lubricated Parts	208
C. Nuts, Bolts and Screws	208
D. Self-locking Nuts	209
E. Lockwire and Cotterpin Requirements	209
F. Slotted, Steel Locknuts (Prevailing Torque Type)	209
G. Standard and Stepped Studs	209
H. Hose, Tubing and Threaded Couplings	209

TABLE OF CONTENTS

SUBJECT	PAGE
STANDARD PRACTICES - MAINTENANCE PROCEDURES (Cont'd)	**70-00-00**
10. Locking Devices	209
A. General	209
B. Keywashers (Tab and Cup Type)	209
C. Retaining Rings	210
D. Installing Lockwire	210
E. Installing Safety Cable	212
11. Identification of Hardware Material, Particularly Nuts and Bolts	228
12. Stainless Steel Bolts with Reduced Pitch Diameters	230
13. Identification of Metal Particles	232
A. General	232
B. Test Procedure	232
C. Test Procedure for Identification of Titanium Particles	233
14. Marking of Parts	234
A. General	234
B. Permanent Marking Methods	234
C. Temporary Marking Methods	235
STANDARD PRACTICES - REMOVAL/INSTALLATION	**70-00-00**
1. General	401
2. Consumable Materials	401
3. Special Tools	401
4. Fixtures, Equipment and Supplier Tools	401
5. Removal/Installation	401
A. General Removal and Installation Practices	401
B. Removal of Straight Nipples, Straight Adapters, Bulkhead Couplings and Tube Connector Nipples.	402

TABLE OF CONTENTS

SUBJECT	PAGE
STANDARD PRACTICES - REMOVAL/INSTALLATION (Cont'd)	**70-00-00**
C. Removal of Tube-to-Boss Elbows, Elbow Adapters and Elbow Assemblies	402
D. Lubrication of Preformed Packings	403
E. Installation of Straight Nipples, Straight Adapters, Bulkhead Couplings and Tube Connector Nipples	403
F. Installation of Tube-to-Boss Elbows, Elbow Adapters and Elbow Assemblies	403
STANDARD PRACTICES - INSPECTION	**70-00-00**
1. General	601
2. Consumable Materials	601
3. Special Tools	601
4. Fixtures, Equipment and Supplier Tools	601
5. Inspection	601
A. Standard Checks	601
B. Inspection Gages	602
C. Inspection of Fuel, Oil and Air Filters	602
D. Inspection of Welded Repairs	602
E. Inspection of Fuel, Oil and Air Tubes	602
F. Inspection of Rotating Components	604
STANDARD PRACTICES - CLEANING	**70-00-00**
1. General	701
2. Consumable Materials	701
3. Special Tools	701
4. Fixtures, Equipment and Supplier Tools	701
5. Cleaning	701
A. General Precautions	701

TABLE OF CONTENTS

SUBJECT	PAGE
STANDARD PRACTICES - CLEANING (Cont'd)	**70-00-00**
B. Cleaning Precautions	701
C. Cleaning Before Welding	702
STANDARD PRACTICES - REPAIR	**70-00-00**
1. General	801
2. Consumable Materials	801
3. Special Tools	801
4. Fixtures, Equipment and Supplier Tools	801
5. Welding Repairs	802
A. General	802
B. Welding Equipment	802
C. Cleaning Before Welding	802
D. Welding Procedures	802
E. Cleaning After Welding	803
F. Local Stress Relief	804
G. Inspection of Welding	804
H. Blend Repair Procedure	804
6. Blend Repairs	804
A. Blend Repair Procedure	804
7. Helical Coil Inserts	804
A. Replacement of Helical Coil Inserts	804
8. Studs	805
A. Replacement of Studs	805
B. Repair of Damaged Stud Hole	806
9. Corrosion Treatment	807
A. Magnesium Alloy Components	807

TABLE OF CONTENTS

SUBJECT	PAGE
STANDARD PRACTICES - REPAIR (Cont'd)	**70-00-00**
10. Shanknuts	808
A. Replacement	808

STANDARD PRACTICES - MAINTENANCE PROCEDURES

1. General

   A. The following describe the standard practices and techniques employed during maintenance of gas turbine engines. Procedures for servicing, inspection, cleaning and repair are included.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC01-001	Engine Fuel
PWC03-001	Engine Oil
PWC04-001	Synthetic Grease
PWC05-002	Dye Layout Marker
PWC05-004	Hydrofluoric Acid
PWC05-006	Phosphoric Acid
PWC05-009	Ammonium Bifluoride Crystals
PWC05-011	Ammonium Nitrate
PWC05-018	Metal Marking Crayon
PWC05-038	Hydrogen Peroxide
PWC05-046	Ink Marker
PWC05-046A	Ink Marker
PWC05-046B	Ink Marker
PWC05-046C	Ink Marker
PWC05-048	Pen Marker
PWC05-048A	Pen Marker
PWC05-048B	Pen Marker
PWC05-056	Sodium Hydroxide
PWC05-058	Tin Solder
PWC05-074	Sulfuric Acid
PWC05-089	Lockwire
PWC05-103	Wax Pencil Marker
PWC05-195	Nitric Acid
PWC05-196	Hydrochloric Acid
PWC05-344	Safety Cable Kit
PWC06-002	Petrolatum
PWC06-004	Anti-seize Compound (paste)
PWC06-004A	Anti-seize Compound (powder)
PWC06-006	Anti-seize Compound (grease)
PWC06-032	Anti-galling Compound
PWC11-027	Petroleum Solvent

3. Special Tools

The special tools listed below are used in the following procedures.

Tool No.	Name
PWC90025	Crimper
PWC90026	Test Block

4. Fixtures, Equipment and Supplier Tools

The fixtures, equipment and supplier tools listed below are used in the following procedures.

Name	Remarks
Permanent Magnet	Local Purchase
Spot Plate, White Porcelain	Local Purchase
Soldering Iron	Local Purchase
Burner	Local Purchase

5. General

A. To ensure proper reinstallation, tag and mark all parts, clips, and brackets as to their location.

CAUTION: DUST CAPS USED TO PROTECT OPEN TUBES AGAINST CONTAMINATION SHALL ALWAYS BE INSTALLED OVER THE TUBE ENDS AND NOT IN THE TUBE ENDS. FLOW THROUGH THE LINES MAY BE BLOCKED OFF IF LINES ARE INADVERTENTLY INSTALLED WITH DUST CAPS IN THE TUBE ENDS.

B. During removal of tubes or engine parts look for indications of scoring, burning or other undesirable conditions. To facilitate reinstallation, observe the location of each part during removal. Tag unserviceable parts and units for investigation and possible repair.

C. Extreme care shall be taken to prevent dust, dirt, lockwire, nuts, washers or other foreign matter from entering the engine. It cannot be overemphasized that this precaution applies whenever work is done on the engine either on the wing or off the wing. Suitable plugs, caps, and other covering shall be used to protect all openings as they are exposed.

D. If at any time items are dropped into the engine, the assembly process must stop until the dropped articles are located, even though this may require a considerable amount of time and labor. Before assembling or installing any part, be sure it is thoroughly clean.

E. Lockwire, lockwashers, tablocks, tabwashers, or cotterpins must never be reused. All lockwire and cotterpins must fit snugly in holes drilled in studs and bolts for locking purposes. Install a cotterpin so that the head fits into the castellation of the nut, and unless otherwise specified, bend one end of the pin back over the stud or bolt and the other end down flat against the nut. Only lockwire and cotterpins made of corrosion resistant steel shall be used. Bushing plugs shall be lockwired to the assembly boss or case. Do not lockwire the plug to the bushing.

F. Replace all gaskets, packings, and rubber parts at reassembly. Make sure that new nonmetallic parts to be installed (such as an oil seal) show no sign of having deteriorated in storage.

CAUTION: TOOL SURFACES WHICH MAY CONTACT ENGINE CRITICAL AREAS MUST BE ADEQUATELY COVERED WITH A PROTECTIVE MATERIAL.

G. To protect critical areas of engine parts (such as compressor and turbine disks) against scratches and nicks, tool surfaces contacting these areas must be covered with protective material.

H. During replacement of components, note condition of any removed preformed packings. Pieces accidentally torn or cut from packings must be retrieved, regardless of size, even if this entails a systematic disassembly and cleaning of the system. Ensure that new packings are free of cuts, flashings and deformities which may be sheared off at installation.

I. When installing engine parts that require the use of a hammer to facilitate assembly or installation, use only a plastic or rawhide hammer.

J. Whenever adhesive tape has been applied to any part, the tape must be removed and the part thoroughly cleaned of all tape residue with petroleum solvent (PWC11-027) prior to being subjected to high temperature during engine run. Test results indicate that all tapes are capable of causing surface attack and/or reduction in tensile ductility as temperature increases. Do not leave tape or tape residue on engine parts.

K. If any part has been coated with corrosion preventive compounds, all traces of this compound and accumulated foreign matter must be removed.

L. All loop clamps must be installed in accordance with the instructions and illustrations contained in the appropriate chapters throughout this manual.

6. Special Limits and Torque Recommendations

A. General

(1) Reference numbers on “Fits and Clearances”, for applicable chapters, indicate the location of fits, clearances, and parts for which torque and spring pressures are specified. A description of, and limits for, these fits, clearances, torque and spring pressures is located by referring a reference number, given in the text, to the same number given in the appropriate “Fits and Clearances”. In locations where no specific torque limit is given in “Fits and Clearances” the general torque recommendations are specified.

B. Terms and Symbols

(1) The terms and symbols used in “Fits and Clearances” are explained as follows:

(a) REF. DIMENSIONS Column - This column indicates the minimum and maximum manufacturing dimensions of two mating parts. These dimensions are provided for information only.

(b) LIMITS Column - This column indicates the desired minimum and maximum fits and clearances between new parts, and also the allowable limit to which these parts may wear before replacement is necessary (Ref. step (e) NOTES).

(c) The symbol T indicates a tight fit. The symbol L, or no letter after a fit denotes a loose fit.

(d) Unless otherwise specified, all fits are diametrical.

(e) The figures in the MINIMUM, MAXIMUM and REPLACE columns shall be interpreted as follows:

1 Imperial: Torque in pound-inches, spring pressures in pounds, and all other limits in inches.

2 Metric: Torque in newton-meters, spring pressures in newtons, and all other limits in millimeters.

NOTE: 1. Where the replace column is left blank, the minimum or maximum limit applies, as required.

NOTE: 2. Where minimum and maximum figures are given for torque loads, they represent the intended tightening range.

(f) The expression FIT TO is used when an operation may be required at assembly to obtain the required fit.

(g) An asterisk (*) in the 'Replace' column indicates that parts should be replaced if any looseness is found.

(h) The number symbol (#) indicates that parts should be replaced when scuffing, pitting, galling or excessive wear has taken place.

(i) Spline fits are calculated from chordal dimensions; unless otherwise specified, all other fits are diametrical.

7. Standard Torques

A. Torque Limit Values

Torque limits given in the following chapters are to be interpreted as follows:

(a) Torque values in pound-inches at room temperature.

(b) Angles of turn in degrees.

(c) Stretch values in inches.

B. Lubricants

Unless otherwise specified, thread lubricant shall be engine oil (PWC03-001) and shall be applied to parts which are to be torqued.

C. Tightening Procedures

(1) If the part to be tightened is hot, allow sufficient time for the part to reach temperature equilibrium with the surrounding area before final torquing.

(2) Flange bolts shall be drawn up evenly. This can be achieved by having two mechanics working simultaneously 180 degrees apart.

(3) Torque applications should be done slowly and evenly for consistency and the best possible accuracy.

D. Torque Check For Reuse Of Self-Locking Fasteners

(1) General

Check for adequate torque of self-locking fasteners before reuse. Discard fastener if locking capability is impaired. Do not repair self-locking fasteners.

(2) Torque Limits

(a) Self-locking nuts, self-locking bolts, and self-locking helical coil inserts shall be capable of meeting torque requirements in Table 201.

(b) Heat Resistant Steel Nuts - For torque testing stainless steel, corrosion and heat resistant steel, nickel alloy, and AMS6304 nuts, major, minor and pitch diameters of bolts should be reduced 0.003 inch below dimensions specified for listed 0.190-32 UNF-3A, 0.190-24 UNC-3A and larger bolt sizes (Ref. Table 201).

TABLE 201, Torque Check for Reuse of Self-Locking Nuts, Bolts and Helical Coil Inserts (Pound-inches at Room Temperature and Lubricated With Engine Oil)

Fine Thread Mating Bolt Thread Size	Fine Thread Max Locking Torque	Fine Thread Min Break-away Torque	Coarse Thread Mating Bolt Thread Size	Coarse Thread Max Locking Torque	Course Thread Min Break-away Torque
0.112-48NF-2A	3	0.5	0.112-40NC-2A	3	0.5
0.138-40NF-2A	6	1.0	0.125-40NC-2A	4	1.0
0.164-36NF-2A	9	1.5	0.138-32NC-2A	6	1.0
0.190-32UNF-3A	13	2.0	0.164-32NC-2A	9	1.5
0.250-28UNF-3A	30	3.5	0.190-24UNC-3A	13	2.0
0.3125-24UNF-3A	60	6.5	0.250-20UNC-3A	30	4.5
0.375-24UNF-3A	80	9.5	0.3125-18UNC-3A	60	7.5
0.4375-20UNF-3A	100	14.0	0.375-16UNC-3A	80	12.0
0.500-20UNF-3A	150	18.0	0.4375-14UNC-3A	100	16.5
0.5625-18UNF-3A	200	24.0	0.500-14UNC-3A	150	24.0

TABLE 201, Torque Check for Reuse of Self-Locking Nuts, Bolts and Helical Coil Inserts (Pound-inches at Room Temperature and Lubricated With Engine Oil) (Cont'd)

Fine Thread Mating Bolt Thread Size	Fine Thread Max Locking Torque	Fine Thread Min Break-away Torque	Coarse Thread Mating Bolt Thread Size	Coarse Thread Max Locking Torque	Course Thread Min Break-away Torque
0.625-18UNF-3A	300	32.0	0.5625-12UNC-3A	200	30.0
0.750-16UNF-3A	400	50.0	0.625-11UNC-3A	300	40.0
0.875-14UNF-3A	600	70.0	0.750-10UNC-3A	400	60.0
1.000-14UNF-3A	800	92.0	0.875- 9UNC-3A	600	82.0
1.125-12UNF-3A	900	117.0	1.000- 8UNC-3A	800	110.0
1.250-12UNF-3A	1000	143.0	1.125- 8UNC-3A	900	137.0

NOTE: * Installation or removal.

NOTE: ** Use the listed bolt sizes for torque testing cadmium plated nuts, carbon steel nuts, alloy steel nuts, and aluminum nuts.

(c) Unplated Nuts - Unplated stainless steel, corrosion resistant steel, nickel alloy, and AMS6304 steel nuts that have threads overcut for plating at assembly, shall be silver plated 0.0003 to 0.0006 inch thick for test purposes, and checked for requirements as given in Table 201 for threaded unplated bolts.

NOTE: Where a non-standard torque value is specified, refer to fits and clearances in applicable chapter.

8. Torque Indicating Devices

A. General

(1) Check torque indicating devices before using, and calibrate by means of weights and a measured lever arm to make sure that there are no inaccuracies. Checking one torque wrench against another is not sufficient. Some wrenches are quite sensitive to the way they are supported during a tightening operation, and every effort must be made to adhere to the instructions furnished by the respective manufacturers.

B. Torque Wrench and Extensions

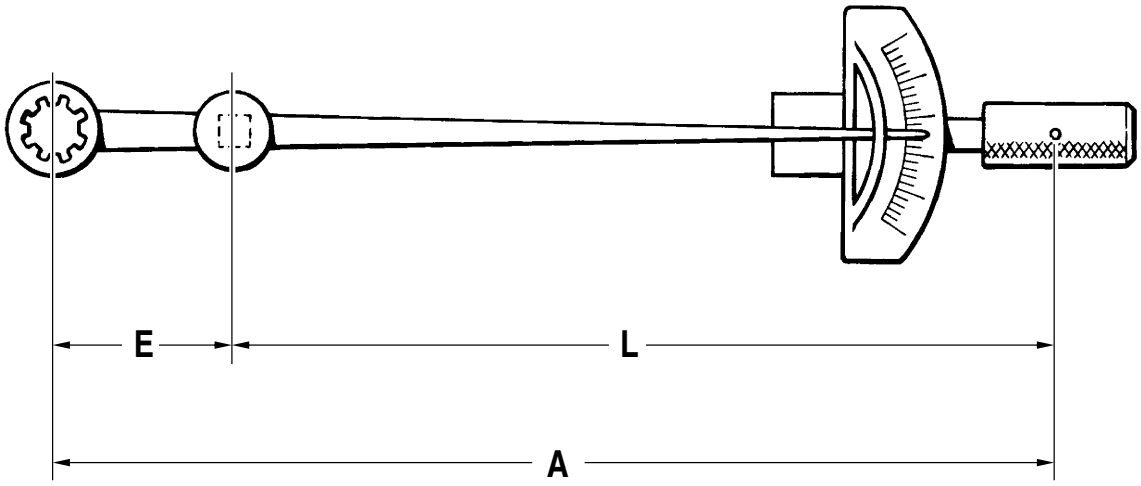
(1) Occasionally, it is necessary to use a special extension, or adapter wrench together with a standard torque wrench (Ref. Fig. 201). In order to arrive at the resultant required torque limits, the following formula shall be used:

T - Desired torque on the part.

E - Effective length of special extension or adapter.

L - Effective length of torque wrench.

A - Distance through which force is applied to part.



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Torque Wrench and Extension
Figure 201

R - Reading on scale or dial of torque wrench.

$$R = \frac{LT}{A} = \frac{LT}{L + E}$$

Example:

A torque of 1440 lb.in. (162.698 Nm) is desired on a part, using special extension having a length of three inches (76.2 mm) from center to center of its holes, and a torque wrench measuring 15 inches (381 mm) from center of handle or handle swivel pin to center of its square adapter. Then:

$$R = \frac{LT}{L + E} = \frac{15 \text{ X } 1440}{15 + 3} = 1200 \text{ lb.in.}$$

$$R = \frac{LT}{L + E} = \frac{381 \text{ X } 162.698}{381 + 76.2} = 135.582 \text{ Nm}$$

With the axis of the extension or adapter and the torque wrench in a straight line, tightening to a wrench reading of 1200 lb.in. (135.582 Nm) will provide the desired torque of 1440 lb.in. (162.698 Nm) on the part.

9. Torque Recommendations

A. General

(1) All nut, bolt and screw torques should be obtained using a thread lubricant. The lubricant should be engine oil, or equivalent, unless otherwise specified. Torque requirements for interference fit application, such as studs and pipe plugs, may be obtained with or without lubrication, unless otherwise specified.

B. Antiseize Lubricated Parts

CAUTION: ENSURE THAT ANTISEIZE AND ANTIGALLING COMPOUNDS ARE APPLIED IN A THIN EVEN COAT, AND THAT EXCESS COMPOUND IS COMPLETELY REMOVED TO AVOID CONTAMINATION OF ADJACENT PARTS, PASSAGES OR SURFACES WHERE THE COMPOUND MAY CAUSE MALFUNCTIONING, OR EVEN FAILURE, OF ENGINE.

(1) Antigalling compound (PWC06-032) should be applied to all loose-fit spline drives which are external to the engine and have no other means of lubrication. For certain assembly procedures, molybdenum disulfide in paste form (PWC06-004), or molybdenum disulfide in powdered form (PWC06-004A) mixed with engine oil (PWC03-001) or grease (PWC04-001), may be used. Particular applications of molybdenum disulfide are indicated in the individual text portions of this manual, as applicable.

C. Nuts, Bolts and Screws

(1) Bolts and nuts on flanges with metal tabular gaskets must be initially torqued to the required torque and then retorqued until torque values given in relevant assembly instruction remain constant.

(2) The torque values given within text apply to nuts where the height of the nut is approximately equal to the major diameter of the thread. For jam nuts, refer to REMOVAL/INSTALLATION. Values do not apply to hollow bolts and screws.

D. Self-locking Nuts

(1) Check effectiveness of self-locking feature before reinstallation. Reject damaged nut.

E. Lockwire and Cotterpin Requirements

(1) When tightening a castellated nut, alignment of slot must be obtained without exceeding the maximum torque. If this is not possible, replace nut with another one. After tightening nut to recommended torque, nut must not be loosened to permit insertion of lockwire or cotterpin. If slot in nut or lockwire hole in bolt or screw is not correctly aligned at the minimum torque value given, the nut, screw or bolt should be further tightened to next alignment position, but maximum torque value given must not be exceeded. Should alignment still be impossible without exceeding maximum torque, back off nut, screw or bolt one-half turn and retorque.

F. Slotted, Steel Locknuts (Prevailing Torque Type)

(1) Effective locking of slotted, steel locknuts on bolts or studs requires full engagement of all locknut threads. The chamfered section of the locknut ID does not exert force on the bolt or stud; therefore, it is not necessary that the bolt or stud be flush with, or protrude from, the outer face of the locknut.

G. Standard and Stepped Studs

(1) When the torque required to drive a stud to the correct protrusion does not reach the minimum value given, or exceeds the maximum value given, a new stud must be selected.

H. Hose, Tubing and Threaded Couplings

(1) If leakage occurs at a coupling, do not attempt to correct by overtightening. Disassemble fitting and check for nicks, burrs and/or foreign matter. Use new parts to rectify.

10. Locking Devices

A. General

(1) Refer to Paragraph 5. for general information on locking devices.

B. Keywashers (Tab and Cup Type) (Ref. Fig. 202)

CAUTION: KEYWASHERS ARE TO BE USED ONCE ONLY. INSTALL NEW KEYWASHER(S) AT EACH ASSEMBLY.

CAUTION: DO NOT USE SHARP EDGED TOOLS TO BEND OR SET KEYWASHER TABS. TAB DETACHMENT MAY OCCUR WITH SUBSEQUENT DAMAGE TO ENGINE.

(1) Pre-Assembly Requirements for Cupwashers:

(a) Visually inspect cupwasher for freedom from deep drawing score marks (especially in undercut adjacent to tangs) and for freedom from prior assembly/handling damage, i.e. bent tangs or prior stake marks.

(b) Visually inspect contact surfaces for excessive roughness, burrs, or scores that may cause the washer to bend on the nut.

(c) Visually inspect the nut for burrs, nicks or scratches on face which abuts the cupwasher that could cause the nut to pick up on the washer.

(2) Assembly Requirements for Cupwashers:

(a) The cupwasher must be lubricated on the nut side only, the opposite face must be clean and dry.

(b) With cupwasher placed against shaft slots opposite to direction of nut tightening, screw nut fingertight.

(c) With a silver pencil (PWC05-018), make an alignment mark on cupwasher outside diameter and the component immediately adjacent to cupwasher.

(d) Torque the nut in the normal manner.

(e) If alignment mark has moved, remove and discard cupwasher.

(f) Repeat procedure with new cupwasher.

(g) Stake cupwasher.

C. Retaining Rings

CAUTION: THOROUGHLY INSPECT ALL RETAINING RINGS, INCLUDING SPIROLOX, FOR CONDITION. DISTORTED RINGS ARE NOT ACCEPTABLE AND MUST BE REPLACED.

(1) Retaining rings must be installed using approved retaining ring pliers. Internal type rings must not be compressed beyond the point where the ends of the ring meet. External type rings must be expanded just enough to allow installation without becoming bent. After installation, ensure that each ring is completely seated, without looseness or distortion in its groove.

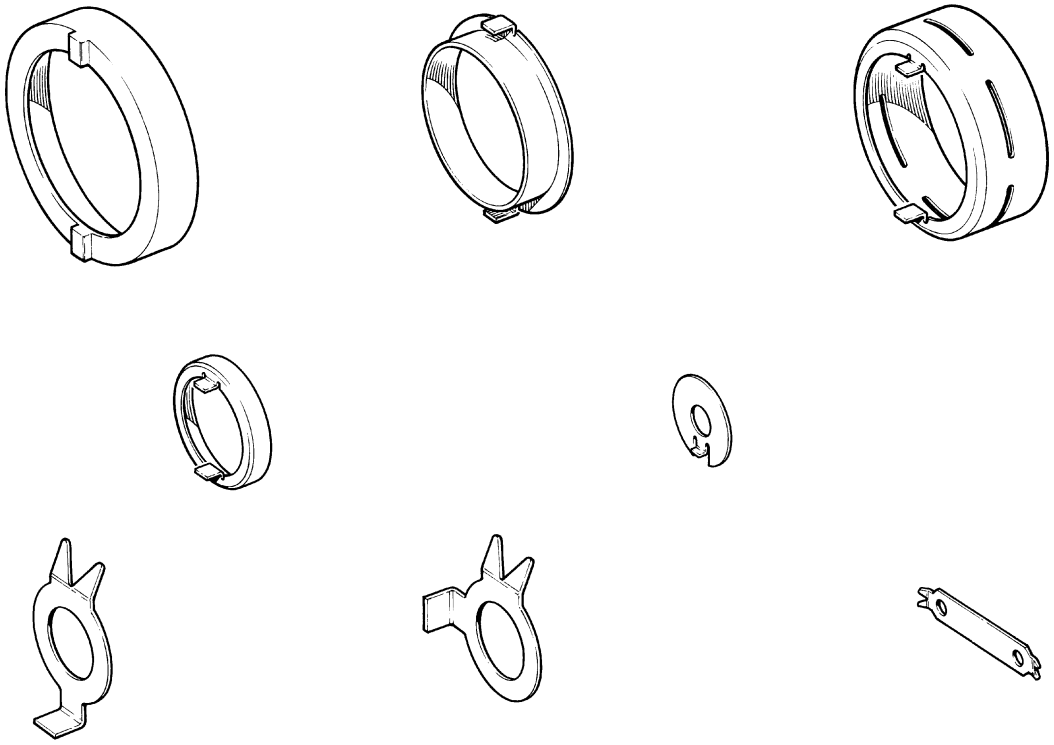
D. Installing Lockwire (Ref. Figs. 203 and 204)

(1) Except where otherwise specified, use heat and corrosion resistant steel lockwire of 0.025 inch diameter (PWC05-089).

(2) Basic Rules

(a) Lockwire must be tight after installation to prevent failure due to rubbing or vibration.

(b) Lockwire must be installed in a manner that tends to tighten and keep a part locked in place thus counteracting the natural tendency of the part to loosen.



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Examples of Lockwashers
Figure 202

(c) Lockwire must never be overstressed. It will break under vibrations if twisted too tightly. The lockwire shall be pulled taut when being twisted, but shall have minimum tension, if any when secured.

(d) Lockwire ends must be bent toward the engine, or part, to avoid sharp or projecting ends which might present a safety hazard or vibrate in the air stream.

(e) Internal wiring must not cross over or obstruct a flow passage when an alternate method can be used.

(3) Lockwire Hole Alignment

(a) Check the units to be lockwired to make sure they have been correctly torqued and that the wiring holes are properly positioned in relation to each other. When there are two or more units, it is desirable that the holes in the units be in the same relationship to each other. Never overtighten or loosen units to obtain proper alignment of the holes. It should be possible to align the wiring holes when the units are torqued within the specified limits. However, if it is impossible to obtain a proper alignment of the holes without either over or under torquing, select another unit which will permit proper alignment within the specified torque limits.

(4) Lockwire Twisting

(a) To prevent mutilations of the twisted section of the wire when using pliers, grasp the wire at the ends or at a point that will not be twisted. Lockwire must not be nicked, kinked, or mutilated. Never twist the wire ends off with the pliers and when cutting off ends, leave at least three complete turns after the loop, exercising extreme care to prevent the wire ends from falling into the engine. The strength of the lockwire holes is marginal; never twist the wire off with pliers. Cut the lockwire close to the hole, exercising extreme care.

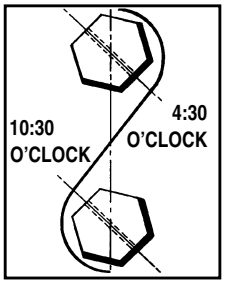
(5) Lockwire Illustrations

(a) Figure 203 illustrates a typical lockwiring procedure. Although there are numerous lockwiring operations performed on these engines, practically all are derived from the basic examples shown in Figure 204.

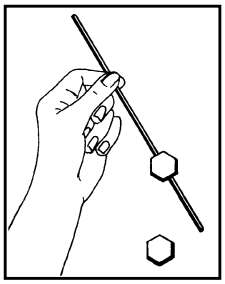
E. Installing Safety Cable (Ref. Figs. 205, 206, 207, 208, 209, 210 and 211)

(1) General

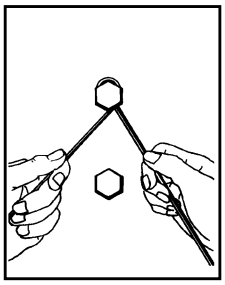
(a) Safety cable is installed through two or more parts in such a way that as the fastener loosens the safety cable will tighten. By tightening, the safety cable will not permit the fastener to loosen or turn. The safety cable system is made up of two components: the safety cable/ferrule kit (PWC05-344) and a crimping tool (PWC90025) (Ref. Fig. 205).



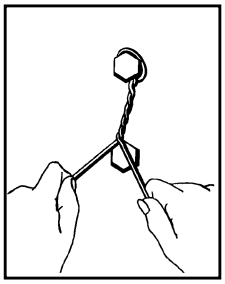
POSITION THE HOLES.



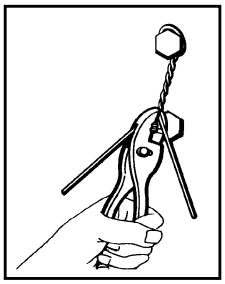
INSERT PROPER GAGE WIRE.



GRASP UPPER END OF THE WIRE AND BEND IT AROUND THE HEAD OF THE BOLT, THEN UNDER THE OTHER END OF THE WIRE. BE SURE WIRE IS TIGHT AROUND HEAD.

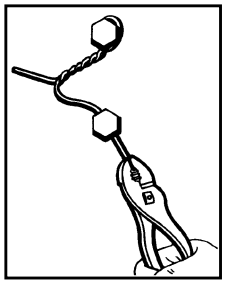


TWIST WIRE UNTIL WIRE IS JUST SHORT OF HOLE IN THE SECOND BOLT.

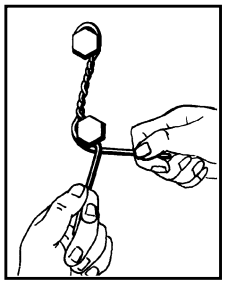


KEEPING WIRE UNDER TENSION, TWIST IN A CLOCKWISE DIRECTION UNTIL THE WIRE IS TIGHT. WHEN TIGHTENED THE WIRE SHALL HAVE APPROXI–MATELY 7 TO 10 TWISTS PER INCH.

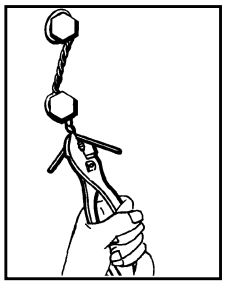
INSERT THE UPPERMOST WIRE, WHICH POINTS TOWARDS THE SECOND BOLT, THROUGH THE HOLE WHICH LIES BETWEEN THE NINE AND TWELVE O'CLOCK POSITIONS. GRASP THE END OF THE WIRE WITH A PAIR OF PLIERS AND PULL THE WIRE TIGHT.



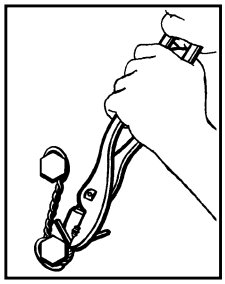
BRING THE FREE END OF THE WIRE AROUND THE BOLT HEAD IN A COUNTERCLOCKWISE DIRECTION AND UNDER THE END PROTRUDING FROM THE BOLT HOLE. TWIST THE WIRE IN A COUNTERCLOCKWISE DIRECTION.



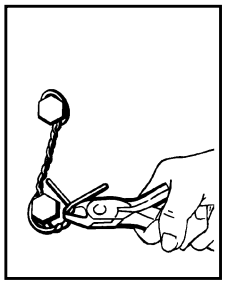
GRASP THE WIRE BEYOND THE TWISTED PORTION AND TWIST THE WIRE ENDS COUNTER–CLOCKWISE UNTIL TIGHT.



DURING THE FINAL TWISTING MOTION OF THE PLIERS, BEND THE WIRE DOWN AND UNDER THE HEAD OF THE BOLT.



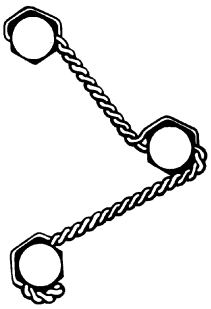
CUT OFF EXCESS WIRE WITH DIAGONAL CUTTERS.



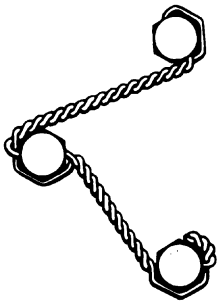
C194C

Lockwiring Procedure
Figure 203

EXAMPLE 1



EXAMPLE 2



EXAMPLE 3

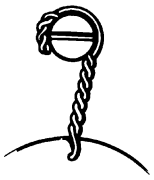
EXAMPLE 4

EXAMPLES 1,2,3 AND 4 APPLY TO ALL TYPES OF BOLTS, FILLISTER HEAD SCREWS, SQUARE HEAD PLUGS, AND OTHER SIMILAR PARTS WHICH ARE WIRED SO THAT THE LOOSENING TENDENCY OF EITHER PART IS COUNTERACTED BY TIGHTENING OF THE OTHER PART. THE DIRECTION OF TWIST, FROM THE SECOND TO THE THIRD UNIT, IS COUNTER–CLOCKWISE TO KEEP THE LOOP IN POSITION AGAINST THE HEAD OF THE BOLT. THE WIRE ENTERING THE HOLE IN THE THIRD UNIT WILL BE THE LOWER WIRE AND BY MAKING A COUNTER–CLOCKWISE TWIST AFTER IT LEAVES THE HOLE, THE LOOP WILL BE SECURED IN PLACE AROUND THE HEAD OF THAT BOLT.

EXAMPLE 5

EXAMPLE 6

EXAMPLE 7



EXAMPLE 8

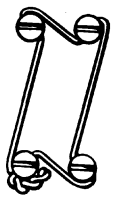
EXAMPLES 5,6,7 AND 8 SHOW METHODS FOR WIRING VARIOUS STANDARD ITEMS. WIRE MAY BE WRAPPED OVER THE UNIT RATHER THAN AROUND IT WHEN WIRING CASTELLATED NUTS OR ON OTHER ITEMS WHEN THERE IS A CLEARANCE PROBLEM.

EXAMPLE 9

EXAMPLE 9 SHOWS THE METHOD FOR WIRING BOLTS IN DIFFERENT PLANES. NOTE THAT WIRE SHOULD ALWAYS BE APPLIED SO THAT TENSION IS IN THE TIGHTENING DIRECTION.

EXAMPLE 10

EXAMPLE 10 SHOWS HOLLOW HEAD PLUGS WIRED WITH THE TAB BENT INSIDE THE HOLE TO AVOID SNAGS AND POSSIBLE INJURY TO PERSONNEL WORKING ON THE ENGINE.

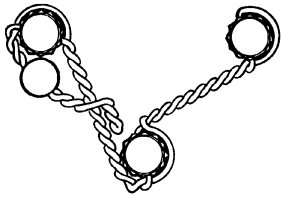


EXAMPLE 11

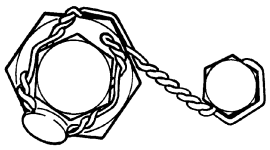
EXAMPLE 11 SHOWS CORRECT APPLICATION OF SINGLE WIRE TO CLOSELY SPACED MULTIPLE GROUP.

C195_1

Lockwiring Examples
Figure 204 (Sheet 1 of 3)



EXAMPLE 12

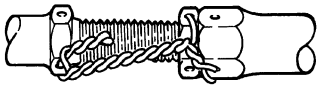


EXAMPLE 13

EXAMPLES 12 AND 13 SHOW METHODS FOR ATTACHING LEAD SEAL TO PROTECT CRITICAL ADJUSTMENTS.

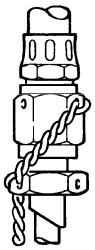
EXAMPLE 14

EXAMPLE 14 SHOWS BOLT WIRED TO A RIGHT ANGLE BRACKET WITH THE WIRE WRAPPED AROUND THE BRACKET.



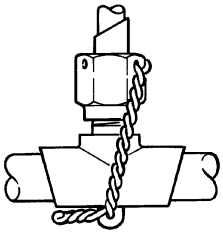
EXAMPLE 15

EXAMPLE 15 SHOWS CORRECT METHOD FOR WIRING ADJUSTABLE CONNECTING ROD.

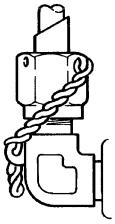


EXAMPLE 16

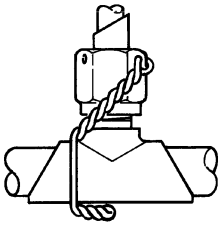
EXAMPLE 16 SHOWS CORRECT METHOD FOR WIRING THE COUPLING NUT ON FLEXIBLE LINE TO THE STRAIGHT CONNECTOR BRAZED ON RIGID TUBE.



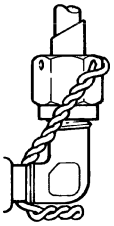
EXAMPLE 17



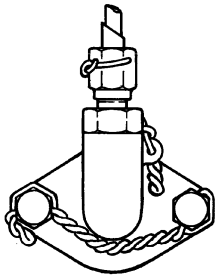
EXAMPLE 18



EXAMPLE 19



EXAMPLE 20



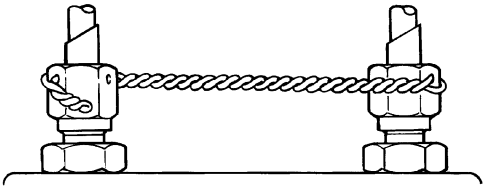
EXAMPLE 21

FITTINGS INCORPORATING WIRE LUGS SHALL BE WIRED AS SHOWN IN EXAMPLES 17 AND 18. WHERE NO LOCKWIRE LUG IS PROVIDED, WIRE SHOULD BE APPLIED AS SHOWN IN EXAMPLES 19 AND 20 WITH CAUTION BEING EXERTED TO ENSURE THAT WIRE IS WRAPPED TIGHTLY AROUND THE FITTING.

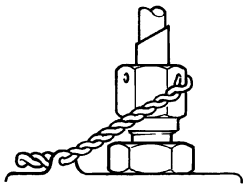
SMALL SIZE COUPLING NUTS SHALL BE WIRED BY WRAPPING THE WIRE AROUND THE NUT AND INSERTING IT THROUGH THE HOLES AS SHOWN.

C195_2

Lockwiring Examples
Figure 204 (Sheet 2)

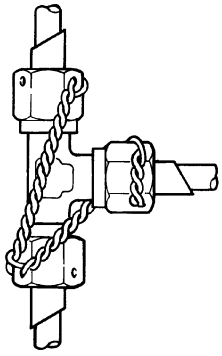


EXAMPLE 22



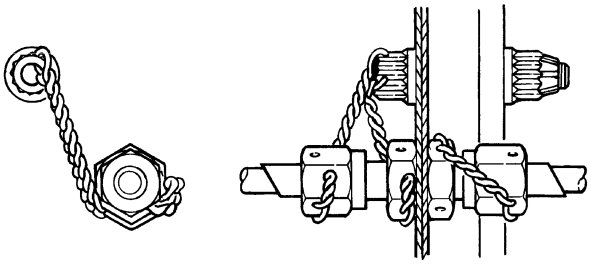
EXAMPLE 23

COUPLING NUTS ATTACHED TO STRAIGHT CONNECTORS SHALL BE WIRED AS SHOWN WHEN HEX IS AN INTEGRAL PART OF THE CONNECTOR.



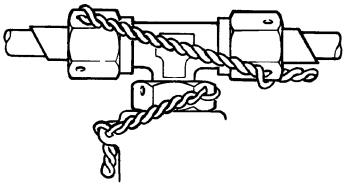
EXAMPLE 24

COUPLING NUTS ON A TEE SHALL BE WIRED AS SHOWN ABOVE SO THAT TENSION IS ALWAYS IN THE TIGHTENING DIRECTION.

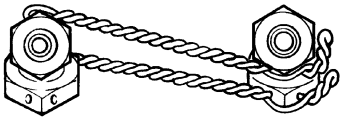


EXAMPLE 25

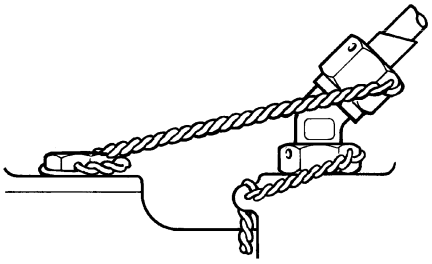
STRAIGHT CONNECTOR
(BULKHEAD TYPE)



EXAMPLE 26



EXAMPLE 27

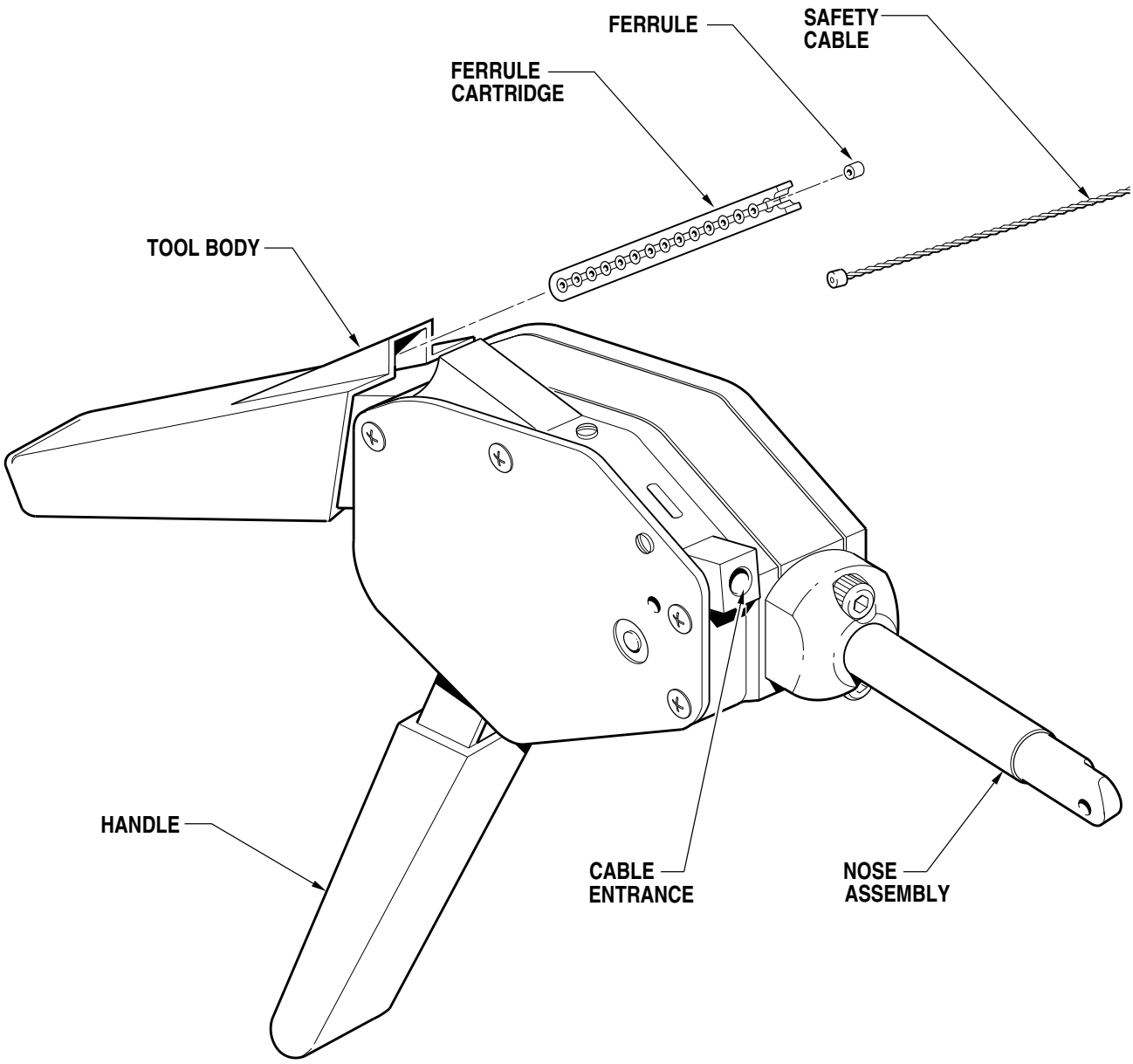


EXAMPLE 28

EXAMPLES 26, 27 AND 28 SHOW THE VARIOUS STANDARD FITTINGS WITH CHECK NUT WIRED SO THAT IT NEED NOT BE DISTURBED WHEN REMOVING THE COUPLING NUT.

C195_3

Lockwiring Examples
Figure 204 (Sheet 3)



C79876

Standard Safety Cable Components
Figure 205

(b) The safety cable is available in one size, 0.32 inch (0.81 mm), and is made of stainless steel material. One end of the cable will have a cable end fitting swaged to it. The cable end fitting is made of stainless steel material. The strands of the cable on the opposite end of the cable are fused together to prevent the cable from fraying.

(c) The ferrules are made of stainless steel material and are purchased in a spring-loaded, disposable cartridge. When the safety cable is installed the ferrule will be crimped on the open end of the cable.

(d) The hand-operated crimping tool comes in two different lengths. The crimping pressure of the tool is set by the manufacturer. The primary parts of the crimping tool are the nose assembly and the tool body. This tool is used to crimp the ferrule on the end of the safety cable. The crimping tool will cut the safety cable even with the ferrule at the same time the ferrule is crimped.

(2) Safety Cable Substitution: Where safety cable is specified, it may be replaced with safety wire. Use safety wire as specified in Table 202.

TABLE 202, Safety Cable Substitution

Nominal Safety Cable Diameter	Safety Wire Substitution
0.032 inch (0.815 mm)	AS3214-02 or MS9226-04
NOTE: Safety wire AS3214 may be used in engine external applications only.	

(3) Basic Installation Rules

(a) It is not permissible to re-use safety cable or a ferrule. The safety cable and ferrule must be new for each application.

(b) Unless specified differently in assembly procedure, safety cable should be installed in double- or triple-bolt patterns. The double-bolt pattern is preferred when you apply safety cable to an even number of fasteners.

(c) Maximum Span: The maximum allowable span of safety cable between two end points is 6 inches (152.4 mm), unless otherwise specified.

(d) Defects: Any defects (such as fray, nicks, kink or any damage to the safety cable) to any portion of the safety cable prior to, during or after installation is not permitted.

CAUTION: DO NOT USE SAFETY CABLE IF THE HOLES ARE MORE THAN 0.100 INCH (2.54 mm) DIAMETER. THE FERRULES ON THE END OF THE CABLE ARE 0.106 - 0.108 INCH (2.69 - 2.74 mm) DIAMETER AND WILL FALL THROUGH HOLES LARGER THAN THIS.

(e) Holes: Always install safety cable through the safety cable holes provided on the fastener.

(f) Hole Alignment: Do not decrease or increase the torque on the parts to correctly align the holes for the cable.

(g) Adjacent Units:

1 Adjacent Units

2 It is recommended that there be no sharp turns more than 90° when the cable is passed through a fastener. Installation of safety cable should be with either a positive or neutral pull.

(h) Cable Flex Limits: Cable flex limits are specified in Figure 209. These values are the maximum flex limits between the end points when light finger pressure of approximately 2 pound (8.9 N) is applied at midspan.

(i) Excess Cable:

1 Cut off excess cable from crimped ferrule after installation of safety cable.

2 Maximum length of cable beyond crimped ferrule is 0.031 inch (0.787 mm).

(j) Safety Cable Seal:

1 Where specified, apply and crimp an aluminum seal to the load bearing portion of the safety cable.

2 After installing the seal, make sure that it is snug on the cable and that it can not be moved without showing evidence of tampering.

3 After installing the seal, an inspection stamp or other means of identification shall be applied to the seal.

(4) Installation (Ref. Figure 207):

(a) Install ferrule cartridge into crimper tool body (PWC90025).

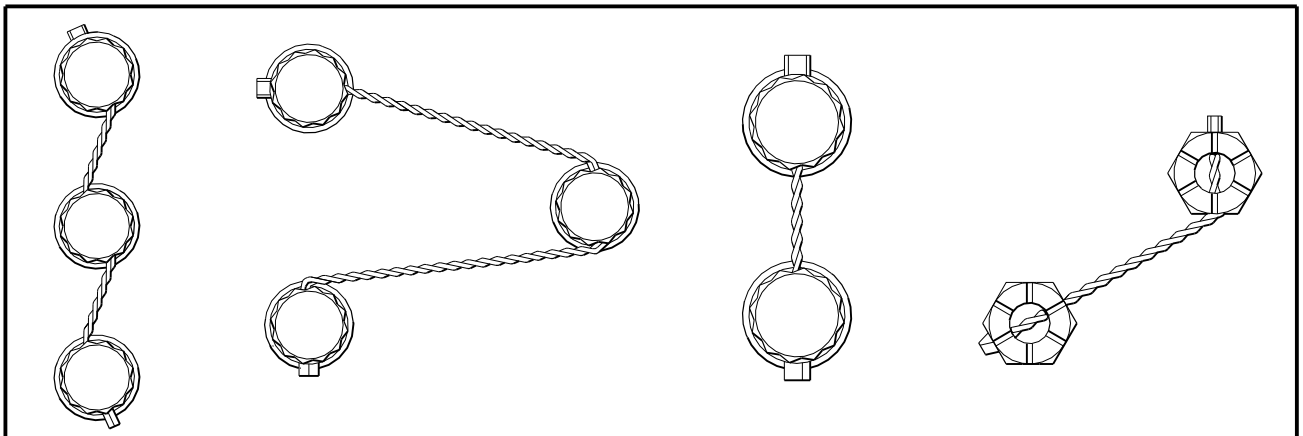
(b) Do a visual inspection of the holes to be used to find all damage. If the hole is damaged, replace the part or, if possible, use another hole to install safety cable.

NOTE: Keep the safety cable as straight as possible when you locking the fasteners or parts together.

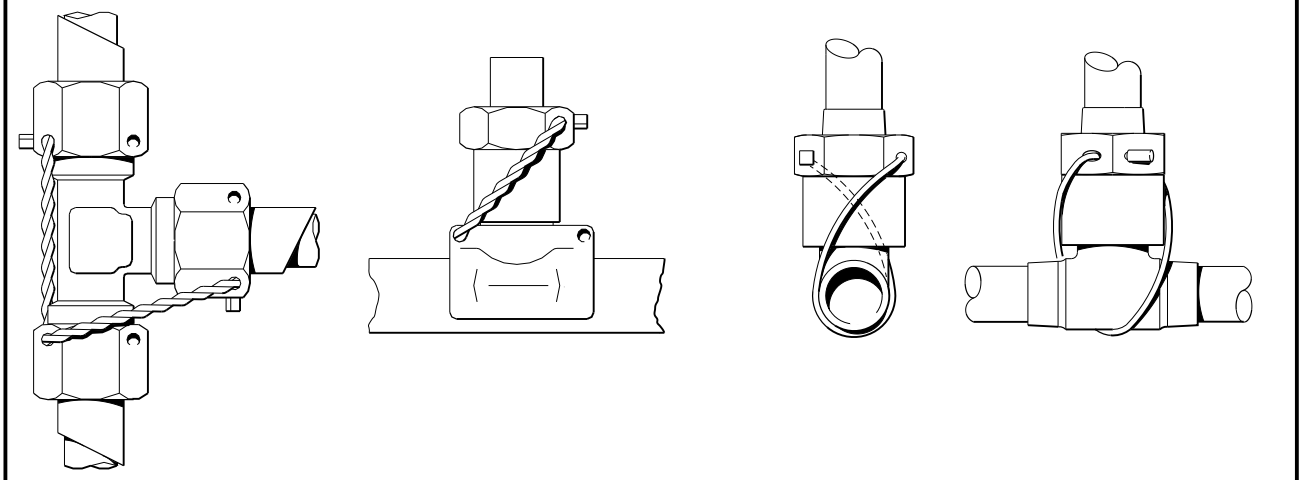
(c) Insert the free end of the safety cable (PWC05-334) into the hole of the part. Pull the cable through the hole until the cable end fitting is against the part.

NOTE: On a double-bolt pattern, do not safety cable in a negative pull direction. Make sure the safety cable has a positive or neutral pull.

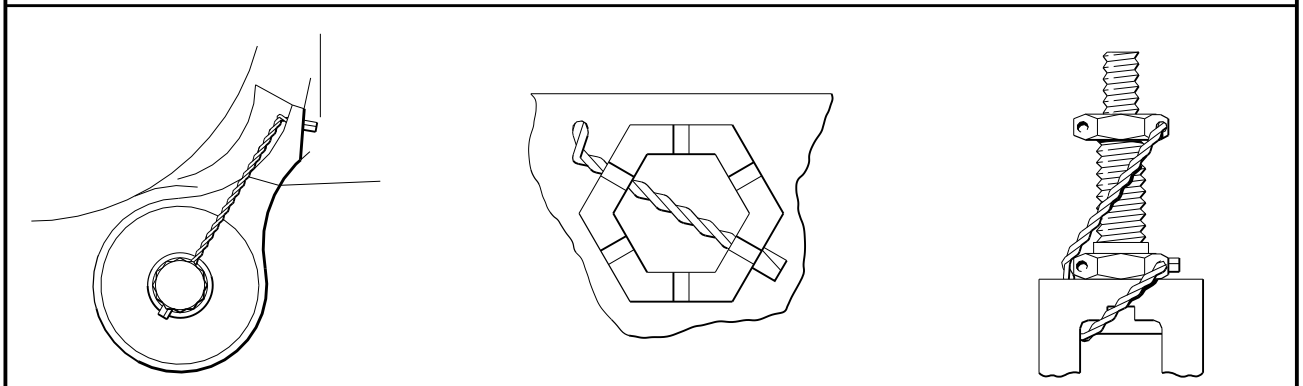
(d) Insert the end of the cable through the second part. Choose the hole in the part that permits the cable to be as straight as possible. Pull the cable through the second part. If three parts must be safety cabled, do the same procedure for the third part.



STANDARD HARDWARE



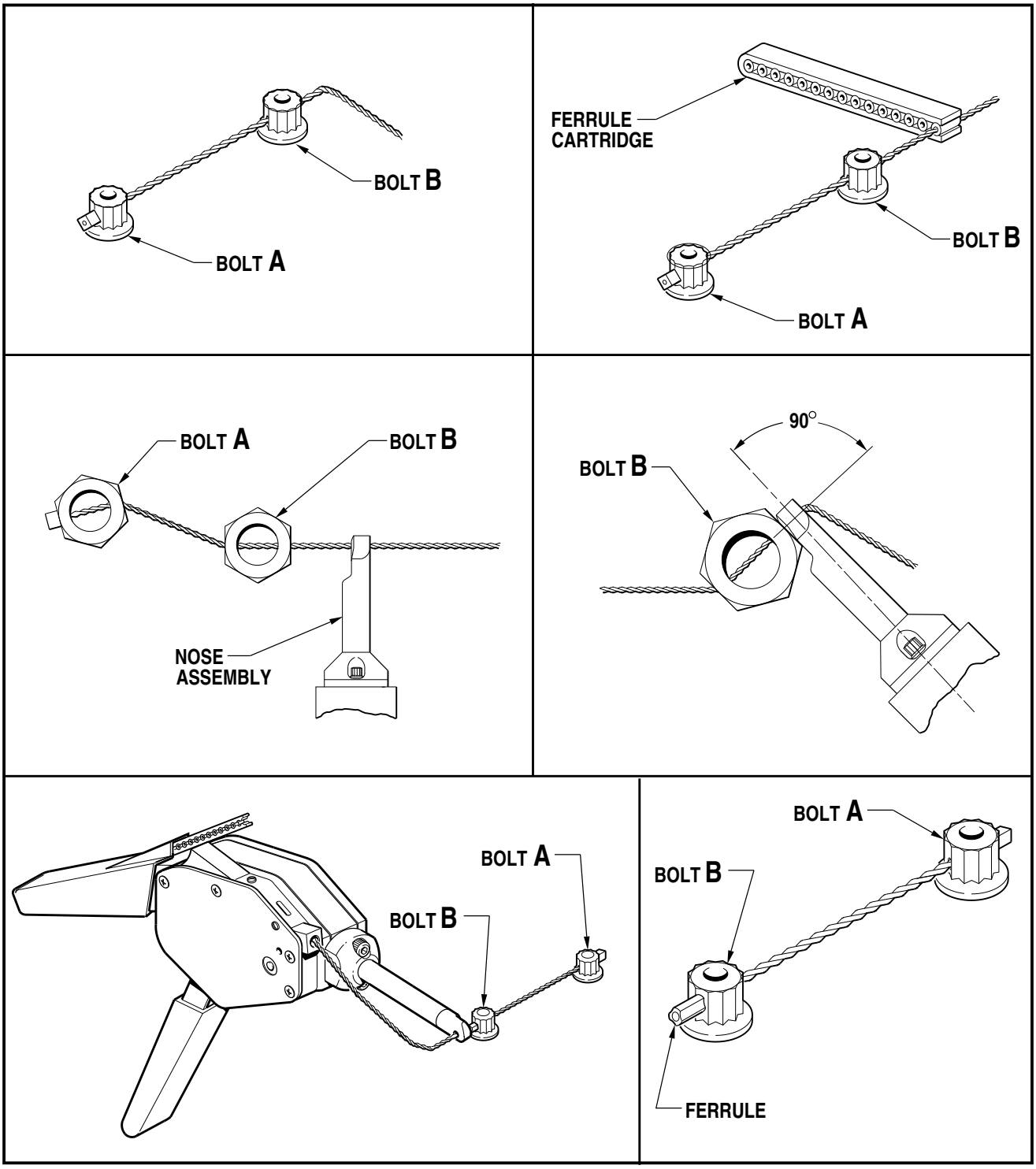
COUPLINGS



OTHER APPLICATIONS

C79877

Safety Cable Safety Cable Patterns
Figure 206



C79878

Safety Cable Installation Procedure
Figure 207

(e) The nose can be changed to four different positions at 90° increments. To select the position, push the nose in towards the tool, rotate to the desired position, and release the nose. If the nose does not lock into the indexed position, turn it slightly until it does (Ref. Figure 208).

(f) Insert the free end of the safety cable through a ferrule (PWC05-334). Use the safety cable to pull the ferrule out of the ferrule cartridge.

(g) Put the end of the safety cable through the crimping head of the crimping tool. Make sure the large hole in the crimping head is on the same side as the ferrule. Move the crimping tool along the safety cable until the crimping head is against the part. Make sure the ferrule goes inside the hole in the crimping head.

(h) Insert the free end of the cable into the cable entrance. Continue to push the cable into the cavity. When the free end of the cable appears at the bottom of the tool, grab the cable and pull the slack from the cable until resistance is felt.

NOTE: Grip the cable as close to the free end as possible during insertion to prevent buckling of the cable.

(i) When all slack is removed from the cable, make sure the tool is snugly against the fastener by using several short strokes of the handle. Release the handle to the full open position and fully close the handle to affect crimping and cutting.

CAUTION: IT IS IMPORTANT ON THIS FINAL STROKE TO HOLD THE TOOL AS STEADY AND PERPENDICULAR TO THE CABLE AS POSSIBLE WHILE ENSURING THAT A FULL STROKE IS USED TO MAINTAIN A CONSISTENT TENSIONING OF THE CABLE.

(j) After crimping and cutting, release the tool handle and slide the tool off the crimped ferrule. Pull the excess cable from the tool.

(k) Remove and discard unused safety cable from the bottom of the crimping tool.

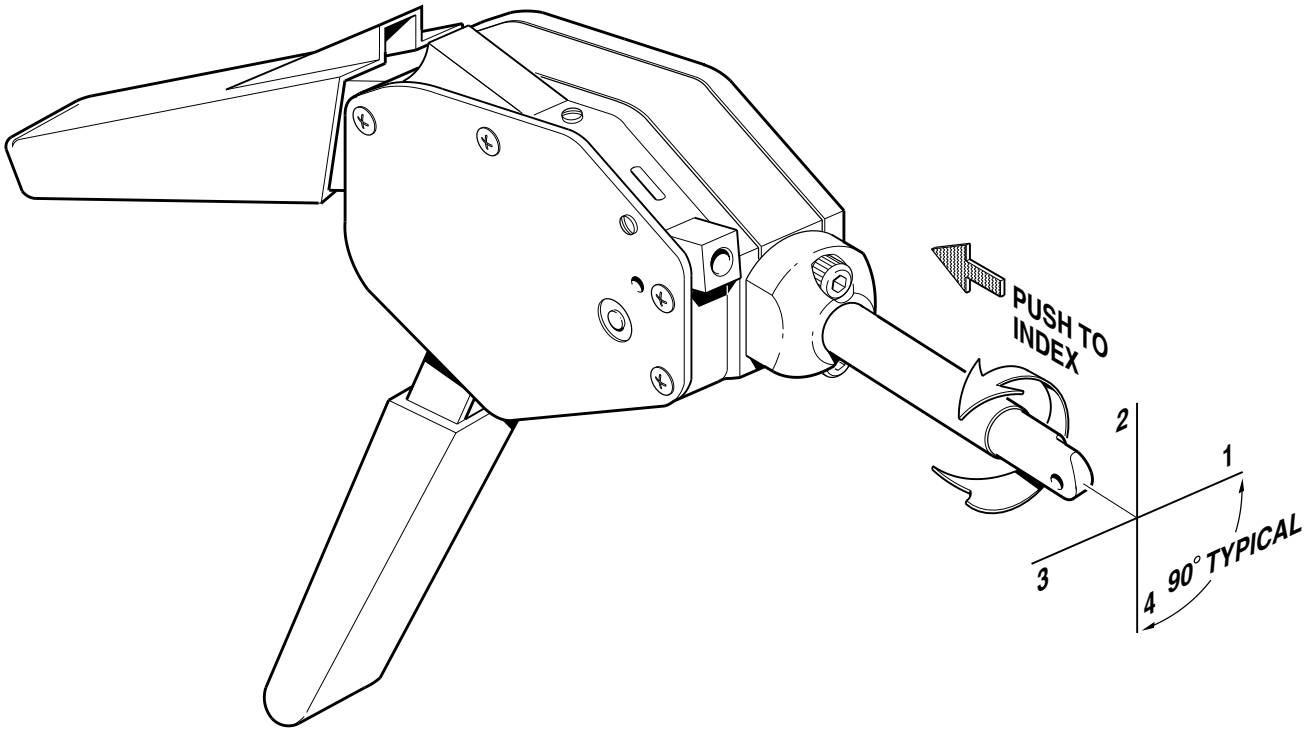
(5) Verification (Ref. Figure 209):

(a) Push against the safety cable with light finger pressure halfway between the locked parts. If the cable feels loose, do a dimensional check to make sure the safety cable is serviceable as follows:

1 Measure the distance between the locked parts. Write this measurement down as Dimension A. If three parts are locked together, measure the distance between each of the parts and add the two measurements together to get Dimension A.

2 Push against the safety cable with light finger pressure halfway between the two locked parts. Measure the distance the safety cable moves laterally. Writes this measurement down as Dimension C.

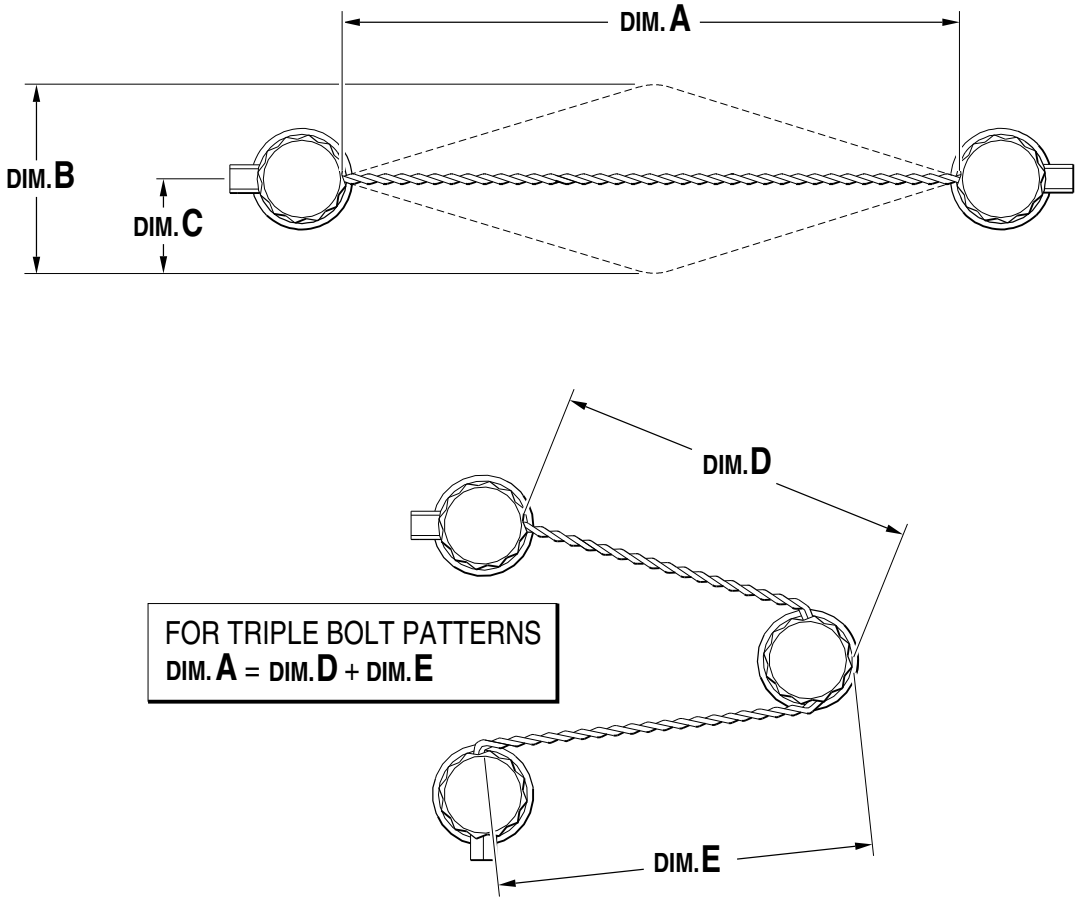
3 Compare the dimensions written down to the limits given.



NOTE: THE NOSE ASSEMBLY CAN BE ADJUSTED TO 4 POSITIONS IN 90° INCREMENTS. TO SELECT THE POSITION, PUSH THE NOSE ASSEMBLY IN AND ROTATE TO THE DESIRED POSITION.

C79879

Nose Assembly Rotation
Figure 208



DIM. A	DIM. B	DIM. C
0.5 IN. (12.7 mm)	0.125 IN. (3.18 mm)	0.062 IN. (1.59 mm)
1.0 IN. (25.4 mm)	0.250 IN. (6.35 mm)	0.125 IN. (3.18 mm)
2.0 IN. (50.8 mm)	0.375 IN. (9.52 mm)	0.188 IN. (4.76 mm)
3.0 IN. (76.2 mm)	0.375 IN. (9.52 mm)	0.188 IN. (4.76 mm)
4.0 IN. (101.6 mm)	0.500 IN. (12.70 mm)	0.250 IN. (6.35 mm)
5.0 IN. (127.0 mm)	0.500 IN. (12.70 mm)	0.250 IN. (6.35 mm)
6.0 IN. (152.4 mm)	0.625 IN. (15.88 mm)	0.312 IN. (7.94 mm)

C79880

Safety Cable Flex Limits
Figure 209

CAUTION: DO NOT TRY TO BREAK THE SAFETY CABLE. IF THE SAFETY CABLE MUST BE REMOVED, CUT THE SAFETY CABLE TO AVOID DAMAGE TO THE HOLES OF THE PART.

(b) If the safety cable is not within limits, cut the safety cable with wire cutters and remove the safety cable. Install new safety cable.

(c) Check that cable was installed through bolts correctly (Ref. Step (4)).

(d) Verify that cable was cut flush at the end of the ferrule with no strand extending more than 1/32 inch from the end of the ferrule.

(e) Visually inspect safety cable for kinks, frayed wires, or improper crimps. Remove and replace safety cable if problem exists.

(6) Indenter Adjustment (Ref. Figure 210):

(a) Remove the nose assembly by removing the two socket head cap screws.

CAUTION: DO NOT ADJUST THE PUSHROD MORE THAN A QUARTER OF A TURN AT A TIME. SEVERE ADJUSTMENTS MAY DAMAGE THE TOOL.

(b) Adjust the pushrod adjustment screw using a 0.25 inch (6.4 mm) straight edge screw driver. Turn the pushrod adjustment screw clockwise to loosen the crimp (enlarge the gaging dimension). Turn the adjustment screw counter-clockwise to tighten the crimp (reduce gaging dimension).

(c) Replace the nose assembly and the two socket head cap screws. Turn each screw a small amount until tight to prevent binding.

CAUTION: TIGHTENING THE CRIMP INCREASES REQUIRED HAND FORCES DURING APPLICATION AND INCREASES CABLE ASSEMBLY TENSILE VALUES. LOOSENING THE CRIMP DECREASES REQUIRED HAND FORCES DURING APPLICATION AND DECREASES CABLE ASSEMBLY TENSILE VALUES

(d) Check calibration as described in (Ref. Para. (7)).

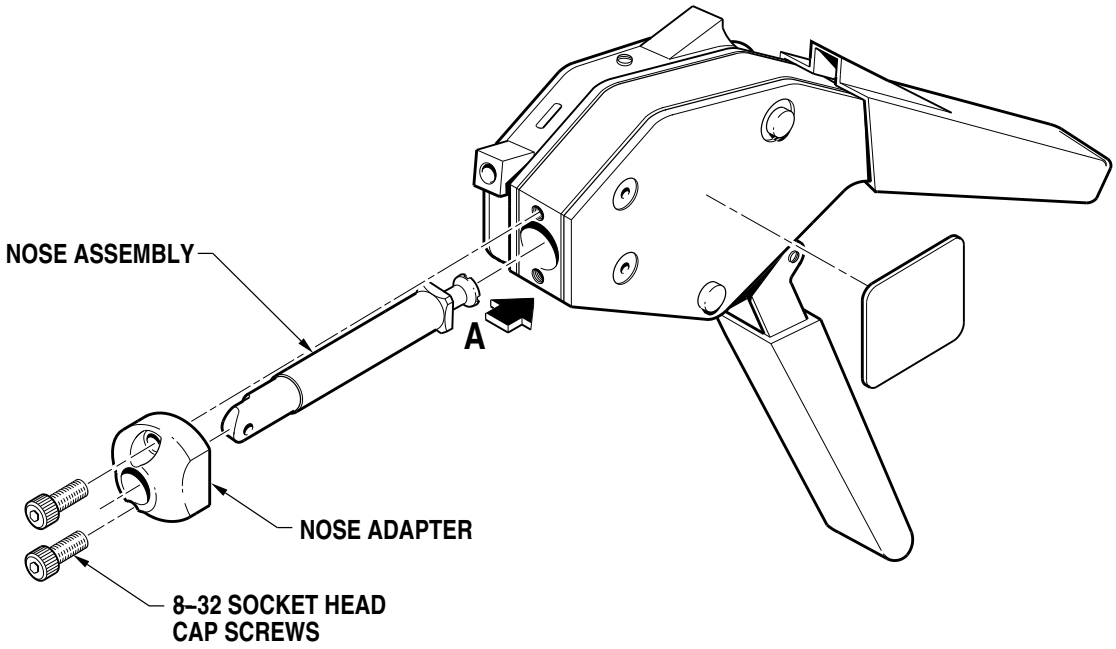
(7) Indenter Calibration (Ref. Figure 211):

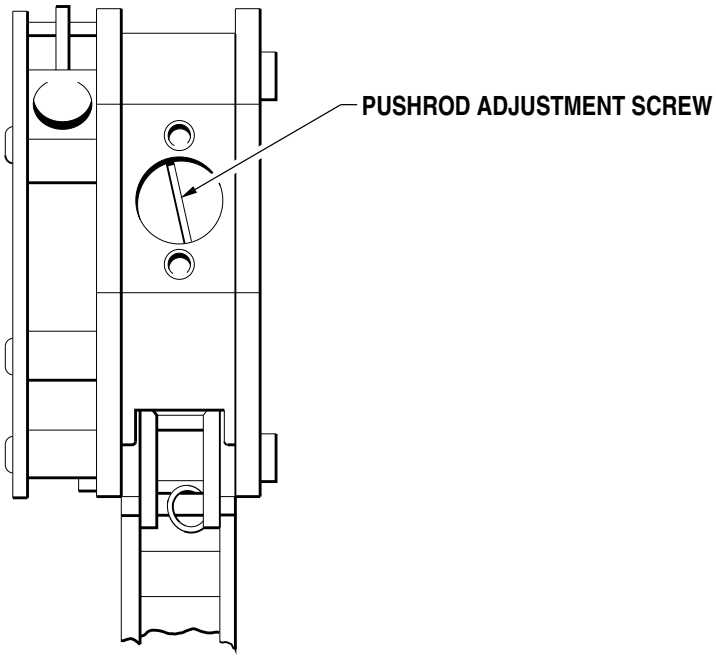
NOTE: 1. Indenter calibration should be checked periodically and must be checked after the nose assembly has been removed or interchanged.

NOTE: 2. Do a pull-off load test as often as necessary to make sure the crimp done by the crimping tool meets the necessary requirements.

(a) Set up test block (PWC90026).

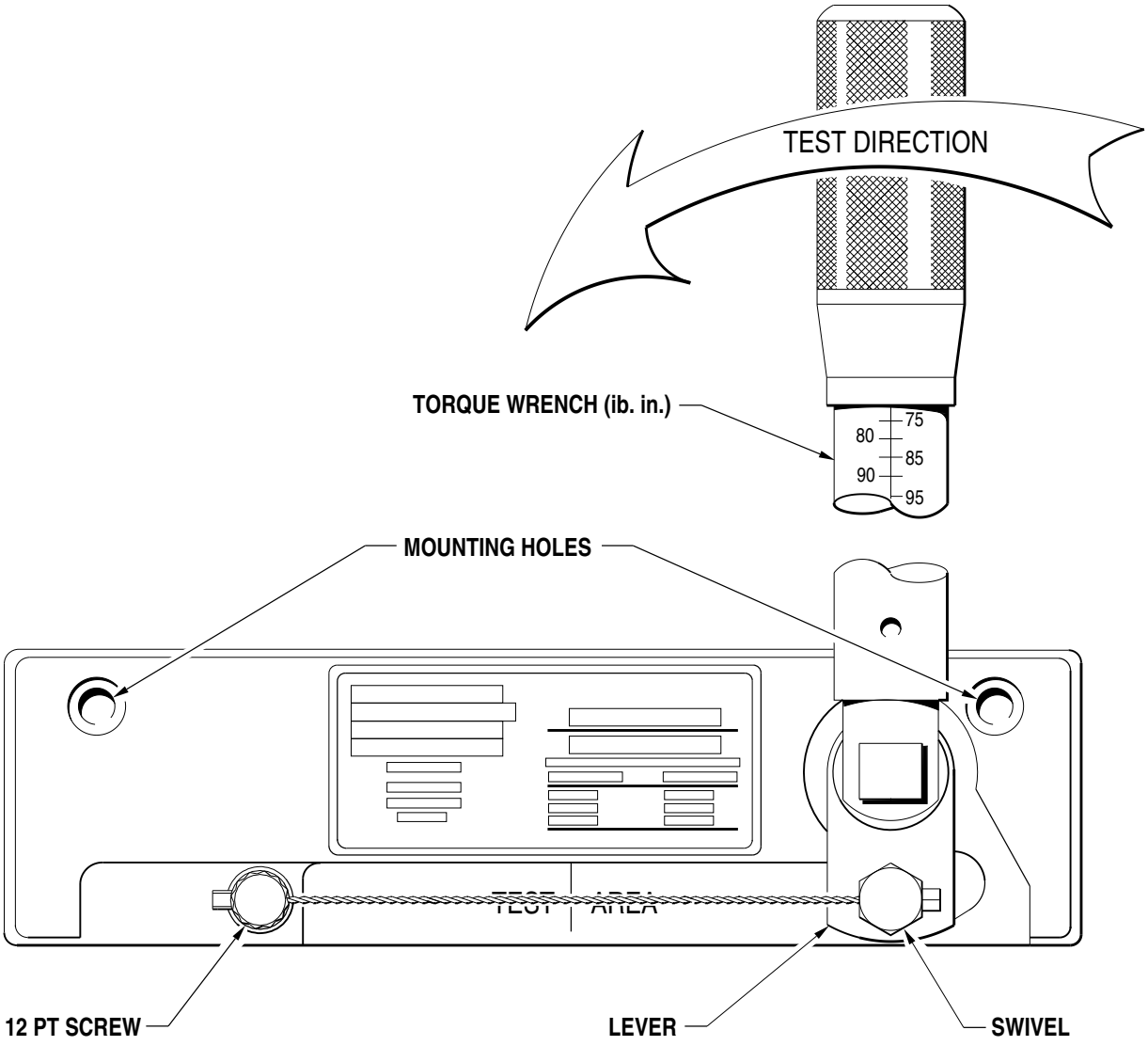
(b) Thread the cable into the 12 point screw and through the swivel, holding the lever in the home position. If the lever is not kept in the home position the results may be adversely affected. Cut the cable by making sure to close the handles completely.





C79882

Indenter Adjustment
Figure 210



C79881

Test Block - Crimper Calibration
Figure 211

(c) Apply approximately 2 lbs. force to the cable with your finger at the line marked test area. If the cable touches either the side or bottom surface of the test area then remove the cable from the test block and use another cable as described in step (b).

(d) Place a 3/8 inch drive torque wrench into the square drive hole, orientating the test block and torque wrench on a flat surface. Apply the proper pull-off load as shown in Table 203. Release torque when minimum pull-off load is achieved.

NOTE: Do not apply additional tension to safety cable than that is required to achieve minimum pull-off load.

(e) If the cable did not break or pull out of the ferrule after applying proper torque, remove the torque wrench and apply approximately 2 lbs. force to the cable with your finger at the line marked test area.

(f) If the cable breaks, touches either the side or bottom surface of the test area or pulls out of the ferrule, then the crimp is unacceptable and the tool indenter should be adjusted (Ref. Step. (6)).

TABLE 203, Safety Cable Minimum Crimp Requirements (Pull-off Load)

Nominal Cable Diameter	Minimum Pull-off Load
.032 Inch (0.81 mm)	70 Inch-Pounds (7.909 Nm)

(8) Maintenance of Crimp Cavity:

(a) Debris can accumulate in the crimp cavity during use. This debris must be removed and the cavity oiled periodically depending upon use and environment.

NOTE: Ferrule sticking can occur if this procedure is not followed.

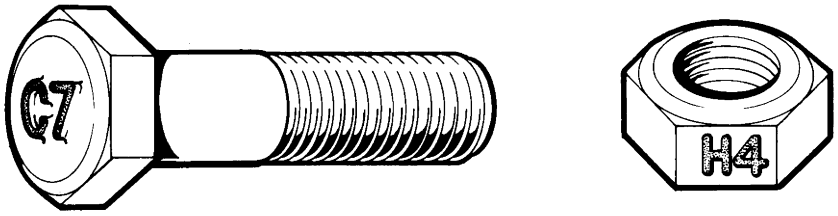
(b) Remove debris by gently scraping or brushing the crimp cavity.

(c) Blow any remaining debris from the cavity with air.

(d) Coat the cavity with a light film of any lightweight synthetic or petroleum based oil after the cavity has been thoroughly cleaned.

11. Identification of Hardware Material, Particularly Nuts and Bolts

A. A permanent type of material code designation has been adopted for use in these engines. Correct engine reassembly procedures require that particular attention be paid to the material requirements for nuts and bolts used in the hot section of the engine. In these areas, where parts must be of material which is resistant to high operating temperatures, special heat resistant alloys are employed. It is imperative that at reassembly of the engine or its components the properly coded part be reassembled in its original location, if serviceable.



C196

Hardware Code Identification
Figure 212

B. The code system employs the use of a letter "C" for corrosion resistant steel for normal application and "H" for heat resistant alloys in hot section application. The stamped or embossed letter will be followed by a number of one or more digits, such as C1, C8, H3, and H12. Bolt code identification will usually appear on the top of the head and nut identification on one side of the hex (Ref. Fig. 212). When the application is an AN or MS six digit part number, the code identification "C" or "H" will be preceded by the letter "E" as in EC3 or EH10.

NOTE: All AN or MS six digit part numbers, when manufactured of material in the common temperature range (such as cadmium plated, low alloy steel parts), are also coded "E" to indicate, in part, close material quality control.

C. The adoption of this program will make it possible for service activities to avoid the assembly of parts, with similar physical appearance, in locations which require high heat resistant parts. In this regard, it is required, at time of disassembly (removal), that all similarly coded parts be segregated so that two, or more, physically similar parts with different code numbers will not be scrambled; and so that, at subsequent reassembly (installation), the properly coded parts are replaced in their proper locations.

CAUTION: NEVER ASSEMBLE A MATERIAL CODED PART WITH A "C" IDENTIFICATION IN A LOCATION WHICH REQUIRES AN "H" CODED PART AND VICE-VERSA. NEVER USE CADMIUM PLATED NUTS, BOLTS OR ANY OTHER CADMIUM PLATED PART IN THE HOT SECTION OF THE ENGINE.

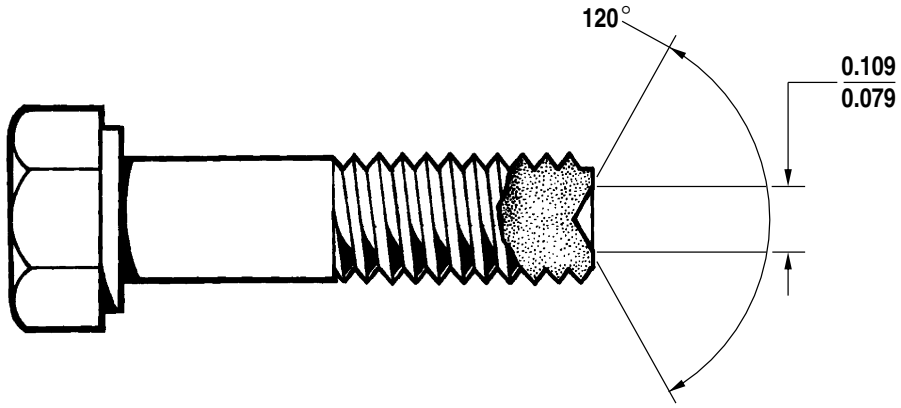
D. Parts from several engines should not be scrambled at disassembly (removal) and cleaning, because, at the time of engine manufacture, production requirements may necessitate one or more material substitutions in a block of engines. Subsequent engine reassembly with indiscriminate scrambling of hardware, may result in unnecessary confusion in sorting these parts for proper reassembly.

CAUTION: IT IS IMPORTANT THAT "J" THREADED HARDWARE BE CAREFULLY SEGREGATED AND MARKED AT DISASSEMBLY (REMOVAL) TO PREVENT MIXING OF "J" THREADED PARTS WITH NON "J" THREADED PARTS.

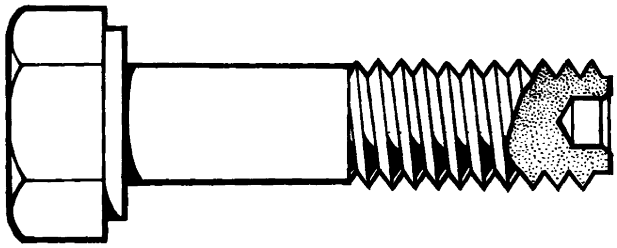
E. Unified Controlled Radius Root "J" Threaded Bolts feature full root radius for external threads with increased minor internal threaded diameter. "J" threads ensure greater fatigue life, improved stress relaxation characteristics and show improvement in tensile strength over previous designs. This thread form is used extensively throughout engines. Engine bolts having "J" threads appear just like items threaded with conventional threads.

12. Stainless Steel Bolts with Reduced Pitch Diameters

At engine manufacture, it is the practice to provide bolts with reduced pitch diameter for use in the hot sections of engines. This will minimize the possibility of bolt and nut seizure and is standard practice for locations where the parts are subjected to elevated temperatures (Ref. Fig. 213).



REDUCED PITCH DIAMETER BOLT



STANDARD BOLT

C197B

Reduced Pitch Diameter Bolt Identification
Figure 213

13. Identification of Metal Particles

A. General

(1) When unidentified particles of metal are found, they may be either steel, tin, aluminum, magnesium, silver, bronze, titanium, or cadmium. In some cases the type of metal may be determined by the color and hardness of the pieces. However, when the particles cannot be positively identified by visual inspection and knowledge of the exact character of the metal is desired as an aid to troubleshooting, a few simple tests will determine the kind of metal present.

WARNING: USE EXTREME CARE IN HANDLING ACIDS.

(2) The following equipment and chemicals are required to make these tests:

- a source of open flame
- permanent magnet
- two ounces of aqueous solution containing ten percent ammonium nitrate (PWC05-011)
- electrical soldering iron
- two ounces each of 50 percent by volume hydrochloric acid (PWC05-196) and concentrated nitric acid (PWC05-195)
- sodium hydroxide pellets (PWC05-056)
- watch glass
- white porcelain spot plate
- ammonium bifluoride crystals (PWC05-009)
- 5 to 10 percent hydrofluoric acid (PWC05-004) or concentrated sulfuric acid (PWC05-074)
- 3 to 10 percent hydrogen peroxide (PWC05-038)
- concentrated phosphoric acid (PWC05-006).

B. Test Procedure

NOTE: The following test procedure is recommended for determining the character of unknown metal particles. For best results, follow the steps as outlined:

(1) Steel - the particles of many steels can be isolated by means of the permanent magnet. Magnetic steel or iron is attracted by the magnet.

WARNING: NEVER ATTEMPT TO BURN MORE THAN A FEW PARTICLES OF METAL SUSPECTED TO BE MAGNESIUM POWDER. DUST IS EXPLOSIVE.

(2) Magnesium - a simple test for these particles is burning. Magnesium will burn with a bright white flash.

(3) Cadmium - place the remaining particles in the aqueous (water) solution of ammonium nitrate (PWC05-011). If all or any of the particles dissolve in this solution, they are cadmium. After this test, rinse and dry any remaining particles.

(4) Tin - the tin particles can be distinguished by their low melting point. With a clean soldering iron, heated to 260°C (500°F) and tinned with 50-50 solder (PWC05-058), a tin particle dropped on the iron will melt and fuse with the solder.

(5) Aluminum - when a particle of aluminum is placed in hydrochloric acid (PWC05-196) 50 percent by volume, it will fizz with a rapid emission of gas bubbles, gradually disintegrate and form a black residue (aluminum chloride). Silver and bronze do not noticeably react with hydrochloric acid.

(6) Aluminum Paint - use this procedure to determine whether or not the material is aluminum silicone paint, aluminum chips, or silver particles.

(a) Make a sodium hydroxide solution by adding one pellet of sodium hydroxide (PWC05-056)to three cubic centimeters of water.

(b) Place several drops of this solution on a watch glass and drop in the suspected particles.

(c) If the particles are aluminum silicone paint, there will be a mild reaction in the form of gas bubbles and some visible gas as the particles change to sodium aluminate.

(d) If the particles are aluminum chips, the reaction will be much more active with many more gas bubbles forming and more visible gas.

(e) If the particles are silver, there will be no reaction.

(7) Silver - when a silver particle is placed in nitric acid, it reacts rather slowly, producing a whitish fog in the acid.

(8) Bronze - when a bronze (or copper) particle is placed in nitric acid, a bright green cloud is produced.

C. Test Procedure for Identification of Titanium Particles

WARNING: THE FOLLOWING CHEMICALS ARE HAZARDOUS AND REQUIRE SPECIAL HANDLING. IT IS RECOMMENDED THAT FOLLOWING TESTS BE CARRIED OUT BY QUALIFIED LABORATORY PERSONNEL.

(1) Place a piece, or pieces of the metal to be identified, on a white porcelain spot plate. A piece of titanium or titanium-bearing metal should be placed on another spot plate to observe and verify the results obtained.

(2) Add several crystals of ammonium bifluoride (PWC05-009)and 5 to 10 drops of water to the metal particles (two or three drops of a solution of 5 to 10 percent hydrofluoric acid PWC05-004 can be used instead).

NOTE: Solid ammonium bifluoride is crystalline and can be conveniently stored in a dry area and used as required.

(3) Let stand 20 to 30 minutes, or until the solution becomes slightly discolored.

(4) Add two or three drops of a solution of one part demineralized water to one part concentrated sulfuric acid (PWC05-074).

(5) Let stand 20 to 30 minutes, or until solution becomes more discolored.

(6) Add three to four drops of 3 to 10 percent hydrogen peroxide (PWC05-038). Solution must not be too old.

(7) If titanium is present, a yellowish color will develop. This yellow color will become progressively darker with time, if allowed to set.

(8) Add two to three drops of concentrated phosphoric acid (PWC06-006), and stir to discharge any yellow color due to the possible presence of iron.

(9) Any light yellow to orange coloration indicates the presence of titanium.

14. Marking of Parts

A. General

(1) Marking of engine parts, assemblies, or weldments shall be applied so as to ensure maximum legibility and durability of mark but in a manner that will not affect function or serviceability of part. Only applicable Pratt & Whitney Canada marking methods shall be used.

(2) Except where otherwise specified, re-identification of parts shall be accomplished adjacent to, or in a location similar to that of, original marking.

(3) All marking characters, unless otherwise specified, shall be 0.060 to 1.160 inch high. In special cases, when marking area is governed by size or configuration of part, characters not less than 0.016 inch nor more than 0.250 inch in height are permitted.

(4) Electric-arc scribing, particularly hand arc scribing, whereby characters are produced by action of an electric arc between surface and an electrode (scriber), has been found unsuitable for jet engine parts and must not be used.

(5) Acid etching, whereby characters are formed by action of an acid on surface of part, is not recommended because of its possible corrosive effect.

(6) Soapstone shall not be used to mark engine parts.

B. Permanent Marking Methods

(1) General

(a) Marking should be done as close to original marking as possible. Permanent methods of marking are those in which marking is legible during entire service life of part.

(b) Permanent markings shall not extend onto any radius, chamfer, sharp edge, or fillet adjoining designated marking surface.

(2) Applied Marking Methods

CAUTION: DO NOT ELECTROLYTICALLY ETCH ANODIZED SURFACES.

(a) Electrolytic Etch - Characters are produced by electrolysis confined to area of characters by a stencil. This technique is sometimes used as a temporary method. Do not confuse it with electric-arc scribing.

(b) Vibration Peening - Characters are produced by a vibrating, radius-tipped, conical tool.

Manual - tool is hand-guided and has a single tip.

Mechanical - tool is mechanically guided and has a single tip, or has multiple tips producing one or more complete characters simultaneously. This method is not usually permitted if hardness of part at time of marking is higher than Rockwell C45 or equivalent. It may be used on parts harder than Rockwell C45 when specifically permitted.

NOTE: Vibration peening marking method can be substituted for marking parts originally marked by diamond drag or roll marking.

C. Temporary Marking Methods

(1) General

(a) Temporary methods of marking are those in which the marking will ensure identification during ordinary handling, storage and final assembly.

CAUTION: LEAD AND/OR METALLIC PENCILS, OR ANY TEMPORARY MARKING METHOD LEAVING A DETRIMENTAL DEPOSIT OF CARBON, ZINC, COPPER, LEAD, OR SIMILAR RESIDUE WHICH MAY CAUSE A REDUCTION IN FATIGUE STRENGTH AS A RESULT OF CARBURIZATION OR INTERGRANULAR ATTACK WHEN THE PART IS SUBJECTED TO INTENSE HEAT, SHALL NOT BE USED. IN THE EVENT THAT AN UNAUTHORIZED MARKING MATERIAL IS USED, THE MARK MUST BE THOROUGHLY REMOVED BY A PROCEDURE DICTATED BY THE MARKING METHOD AND THE PART MATERIAL.

(b) When using a marking pencil, marks shall not be applied to carbon seal plate surfaces or to mating surfaces of finished machined parts. Heavy deposits or marking material could adversely affect clearance and runout.

(2) Applied Marking Methods

CAUTION: ANODIZED SURFACES MUST NOT BE ELECTROLYTICALLY ETCHED.

(a) Electrolytic Etch - Characters are produced by electrolysis confined to area of characters by a stencil. This is primarily a permanent marking method. However, where specified, it may also be used for temporary marking.

(b) Ink Marking

1 Characters are produced by applying, by any means, an ink which does not injure the surface. Inks used in marking may have a light etching action, providing etching does not injure the surface.

NOTE: Ordinarily, ink stamping and electrolytic etching, when used as a temporary marking method, may be applied to any surface which, after assembly, does not move relative to a contacting surface.

(3) Marking Materials for Hot and Cold Section Engine Parts:

Layout Dye (PWC05-002).

Metal Marking Crayon (PWC05-018).

Ink Marker (PWC05-046).

Ink Marker (PWC05-046A).

Ink Markers, Black, Red or Purple (PWC05-048B).

Pen Marker (PWC05-048) .

Pen Marker (PWC05-048A).

Pencil Marker (PWC05-103); may be used on parts which are not directly exposed to the gas path. This type of mark is easily obliterated and, therefore, less durable.

(4) Marking Materials for Cold Section Engine Parts Only:

Ink Marker (Black)(PWC05-046A)

Ink Marker (Black)(PWC05-046B)

Ink Marker (Black)(PWC05-046C)

Ink Marker (White)(PWC05-046C)

(5) Marking Materials for Hot Section Engine Parts Only: use lightly applied layout dye (PWC05-002) to mark parts which are directly exposed to engine gas path such as turbine blades and disks, turbine vanes, and combustion chamber liner.

STANDARD PRACTICES - REMOVAL/INSTALLATION

1. General

   A. The following describe the standard practices employed during removal and installation of threaded fittings.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Engine Oil
PWC06-002	Petrolatum
PWC11-027	Petroleum Solvent

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. General Removal and Installation Practices

      (1) To ensure proper reinstallation, tag and mark all parts, clips, and brackets as to their location.

      (2) During removal of tubes or engine parts look for indications of scoring, burning or other undesirable conditions. To facilitate reinstallation, observe the location of each part during removal. Tag unserviceable parts and units for investigation and possible repair.

      (3) Extreme care shall be taken to prevent dust, dirt, lockwire, nuts, washers or other foreign matter from entering the engine. It cannot be overemphasized that this precaution applies whenever work is done on the engine either on the wing or off the wing. Suitable plugs, caps, and other covering shall be used to protect all openings as they are exposed.

      (4) If at any time items are dropped into the engine, the assembly process must stop until the dropped articles are located, even though this may require a considerable amount of time and labor. Before assembling or installing any part, be sure it is thoroughly clean.

(5) Lockwire, lockwashers, tablocks, tabwashers, or cotterpins must never be reused. All lockwire and cotterpins must fit snugly in holes drilled in studs and bolts for locking purposes. Install a cotterpin so that the head fits into the castellation of the nut, and unless otherwise specified, bend one end of the pin back over the stud or bolt and the other end down flat against the nut. Only lockwire and cotterpins made of corrosion resistant steel shall be used. Bushing plugs shall be lockwired to the assembly boss or case. Do not lockwire the plug to the bushing.

(6) Dust caps used to protect open tubes against contamination shall always be installed over the tube ends and not in the tube ends. Flow through the lines could be blocked if lines are inadvertently installed with dust caps in the tube ends.

(7) Replace all gaskets, packings, and rubber parts at reassembly. Make sure that new nonmetallic parts to be installed (such as an oil seal) show no sign of having deteriorated in storage.

(8) Tool surfaces which might contact critical engine areas such as compressor or turbine disks must be adequately covered with a protective material to prevent scratches and nicks.

(9) During replacement of components, note condition of any removed preformed packings. Pieces accidentally torn or cut from packings must be retrieved, regardless of size, even if this entails a systematic disassembly and cleaning of the system. Ensure that new packings are free of cuts or deformities which may be sheared off at installation.

(10) When installing engine parts that require the use of a hammer to facilitate assembly or installation, use only a plastic or rawhide hammer.

(11) Whenever adhesive tape has been applied to any part, the tape must be removed and the part thoroughly cleaned of all tape residue with petroleum solvent (PWC11-027) prior to being subjected to high temperature during engine run. Test results indicate that all tapes are capable of causing surface attack and/or reduction in tensile ductility as temperature increases. Do not leave tape or tape residue on engine parts.

(12) If any part has been coated with corrosion preventive compounds, all traces of this compound and accumulated foreign matter must be removed.

B. Removal of Straight Nipples, Straight Adapters, Bulkhead Couplings and Tube Connector Nipples.

(1) Remove fittings from engine lines or accessory units.

(2) Remove preformed packings from fittings and discard.

C. Removal of Tube-to-Boss Elbows, Elbow Adapters and Elbow Assemblies

(1) Remove fittings from engine lines or accessory units.

NOTE: Before removal, note angular position of fitting on engine or unit.

(2) Remove preformed packings, packing retainers (back-up rings) and discard. Discard jam nuts from fittings.

D. Lubrication of Preformed Packings

CAUTION: APPLICATION OF LUBRICANT PLUS PROPER ASSEMBLY WILL PREVENT DAMAGE TO PACKINGS WHICH COULD CAUSE ENGINE MALFUNCTION.

(1) Prior to installation, new preformed packings must be coated with a thin film of lubricant to the following specifications:

(a) For packings used in engine fuel system, use engine oil (PWC03-001).

(b) For packings used in engine oil system, use engine oil (PWC03-001).

(c) For packings used in engine pneumatic system assemblies, use petrolatum (PWC06-002).

E. Installation of Straight Nipples, Straight Adapters, Bulkhead Couplings and Tube Connector Nipples

CAUTION: DO NOT BEND, TWIST OR FORCE HYDRAULIC AND PNEUMATIC TUBES, WHETHER RIGID OR FLEXIBLE, TO ACHIEVE ALIGNMENT WITH MATING FITTING. ADJUST FITTING TO ALIGN WITH TUBE. CLAMP AND SECURE TUBE ONLY WHEN IT IS INSTALLED IN POSITION WITH NO NOTICEABLE TENSION OR LOAD.

(1) Lubricate new preformed packing (Ref. Subpara. D.).

(2) Install preformed packing on fitting and screw fitting in boss or flange, as applicable.

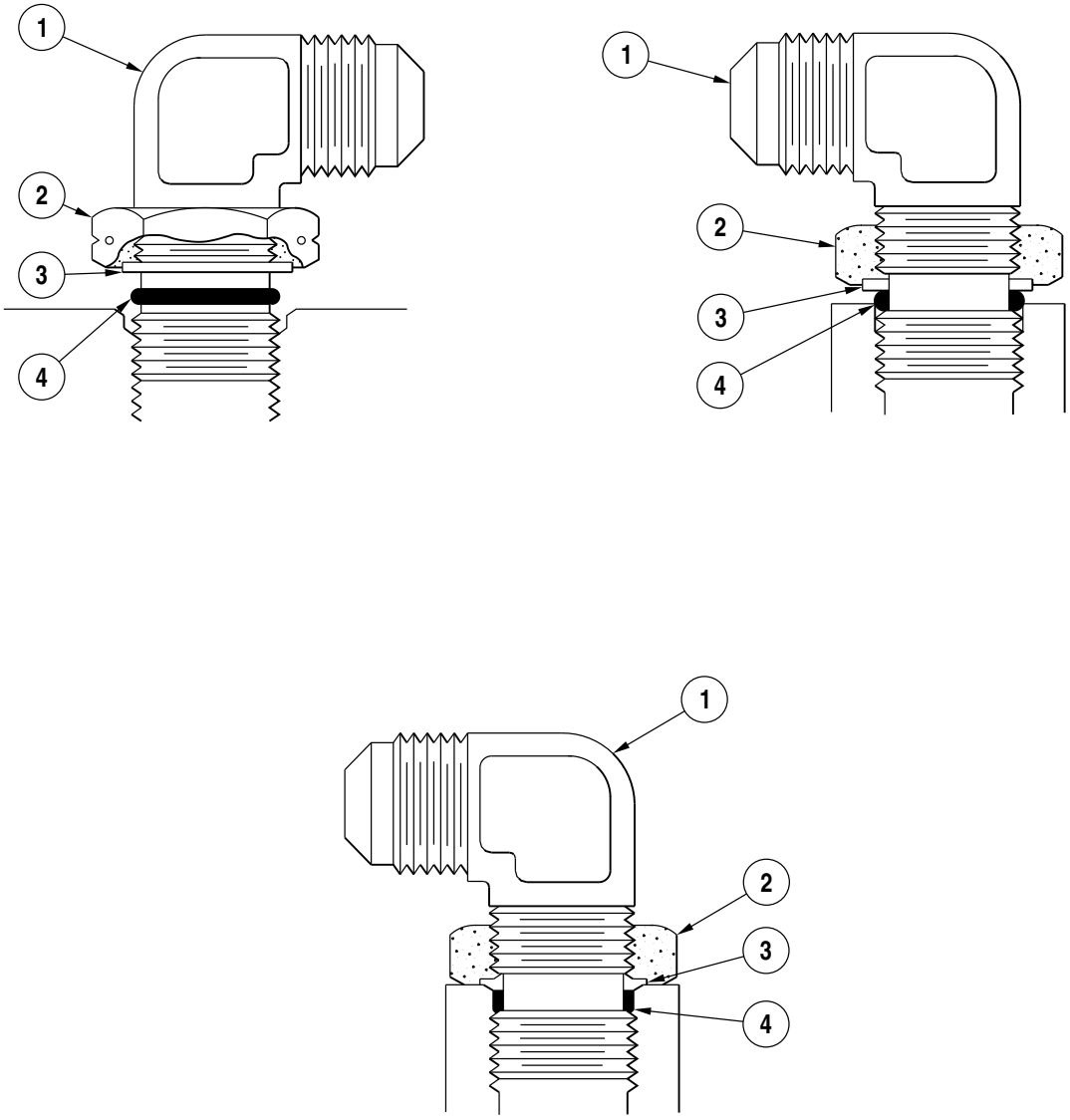
CAUTION: EXCESSIVE TIGHTENING WILL RESULT IN DAMAGE TO THREADS OF MATING PARTS.

(3) Tighten fitting in boss and torque to value detailed in relevant assembly instruction.

(4) Install jam nut on flange mounted fittings and torque jam nut to recommended value (Ref. Table 401).

F. Installation of Tube-to-Boss Elbows, Elbow Adapters and Elbow Assemblies (Ref. Fig. 401)

(1) Lubricate new preformed packings, packing retainer (back-up ring) and thread of elbow fitting (Ref. Subpara. D.).



C3146A

Installation of Typical Elbow Fitting
Figure 401

Key to Figure 401

1. Elbow Fitting
2. Jam Nut
3. Packing Retainer
4. Preformed Packing

TABLE 401, Torque Values for Jam Nuts

THREAD SIZE	TORQUE (lb.in.)
0.250 -28	14 to 16
0.3125-24	22 to 24
0.375 -24	28 to 32
0.4375-20	38 to 42
0.500 -20	58 to 62
0.5625-18	70 to 80
0.625 -18	95 to 105
0.750 -16	145 to 155
0.8125-16	165 to 185

(2) Assemble jam nut, new packing retainer and preformed packing on elbow fitting, pressing packing retainer into counterbore of jam nut.

(3) Turn jam nut down elbow fitting until preformed packing is seated in non-threaded annulus of fitting.

(4) Turn jam nut outward until preformed packing is pushed firmly against first lower thread of fitting.

(5) Install elbow fitting into boss on unit, allowing jam nut to turn with fitting until preformed packing contacts boss mating face. This point will be recognized by increase in torque.

(6) With fitting in this position, hold jam nut stationary and turn elbow fitting into boss a further 1½ turns.

NOTE: From this position the elbow fitting may be further turned inward to a maximum of one turn to facilitate alignment of fitting. Should the fitting tighten in the jam nut before completion of initial 1½ turns or during final alignment, the jam nut may be allowed to turn with the fitting for the remainder of the distance.

(7) With elbow fitting in correct alignment position, tighten jam nut and torque to recommended torque (Ref. Table 401).

NOTE: Metal-to-metal contact between jam nut and boss must be obtained without exceeding recommended torque and there must be no extrusion of preformed packing or packing retainer.

STANDARD PRACTICES - INSPECTION

1. General

   A. A close and complete inspection is important to prolong engine life and give maximum performance. Check for loose or missing parts and inspect any engine part or component that has been worn or damaged. Damage to engine parts may result from improper clearance, lack of lubrication, undesired movement of parts which are bolted, pressed together, overloaded, uneven load distribution, heat, shock, extension of minor damage such as scratches, tool marks, grinding cracks, nicks, etc. Damage to engine parts may also result from presence of foreign matter such as grit, chips, moisture, chemicals, etc., or from incorrect techniques during removal and installation.

   B. While it is frequently possible to repair a damaged part so that it may be safely reinstalled, it is important that the cause of the damage be determined and corrected if possible. Otherwise more serious consequences may result. Some of the physical conditions most commonly encountered during inspection of engine parts are listed in Table 601.

2. Consumable Materials

   Not Applicable

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Inspection

   A. Standard Checks

      (1) Inspect parts for alignment, distortion, foreign matter, looseness, out-of-roundness, sharp edges, scratches, taper, warping and wear.

      (2) Check for holes in cases and check manifolds, pipes and tubes for obstructions.

      (3) Check gear teeth and splines for contact patterns.

      (4) Check magnesium parts for corrosion.

      (5) Check mounting pads, parting and seating surfaces, for smoothness and flatness. Use pencil carbon paper whenever a smear-type indication of surface smoothness is required.

      (6) Check plugs for tightness.

      (7) Check studs, dowels, and similar protruding parts for alignment and projection length.

(8) Check protective surface coatings for completeness.

(9) Check threads for condition.

B. Inspection Gages

(1) When an inspection procedure requires a very accurate measurement, a micrometer, vernier caliper or a dial indicator must be used.

(a) If a micrometer or vernier is to be used, check gage for accuracy before making measurement. Ensure that contacting surfaces are clean and contacting faces of part to be measured are free of dirt and burrs. When using depth gages, ensure anvil is held tight and square against part to be measured.

(b) If a dial indicator is used, ensure indicator base is anchored firmly and that any swivel connections are tightened securely.

(c) When taking measurements with feeler gages, ensure final size of feeler is a reasonably snug fit.

C. Inspection of Fuel, Oil and Air Filters

(1) When determining the condition of engine fuel, oil lubrication and pneumatic systems, removed filters must be inspected for condition, contamination and other defects before the application of any allowable cleaning procedures. Clogged filters could be cause for downstream low pressure in systems.

NOTE: Other engine components will normally be cleaned prior to carrying out inspection procedure.

D. Inspection of Welded Repairs

(1) Inspect weld repair for quality, uniformity, undercutting, cracking and flux removal. Welds must be blended into adjacent metal in gradual, smooth curves. Welds must be sound, clean, free from foreign material, and from internal and external defects which would adversely affect strength of weld.

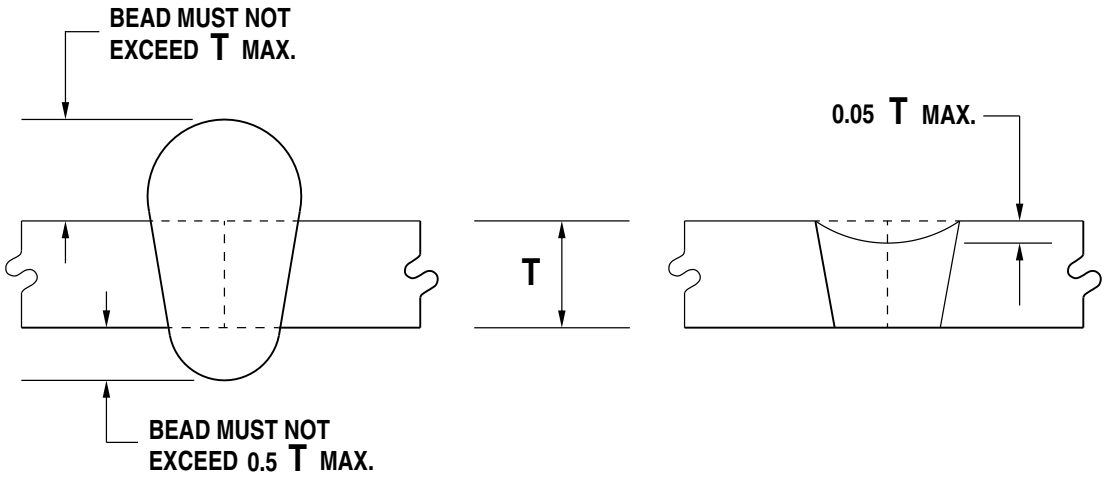
(2) Nominal welds (those not requiring finishing) must exhibit bead conditions as shown in Figure 601, detail A. Finished welds must exhibit bead conditions as shown in detail B.

E. Inspection of Fuel, Oil and Air Tubes

(1) Cracks - Cracked tubing must be replaced. No repair is permitted.

(2) Scratches - Minor scratches having no appreciable depth are acceptable. Scratches to a depth of 0.005 inch must be blended out. Replace tubing with scratches over 0.005 inch deep.

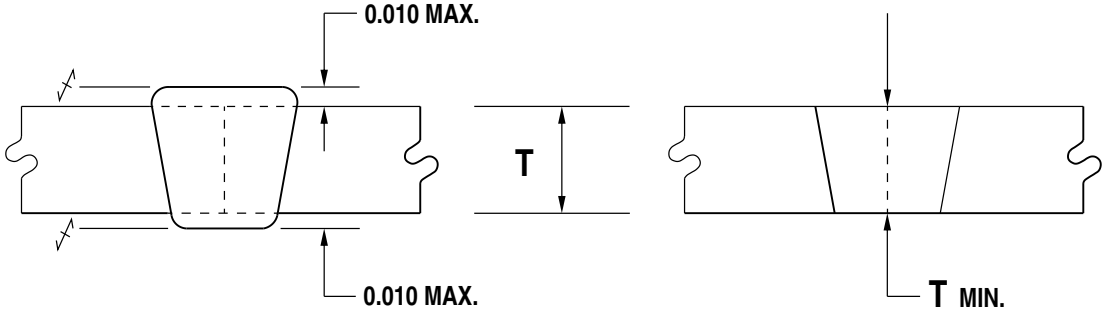
(3) Nicks - Individual nicks up to 0.062 inch long by 0.010 inch wide and 0.003 inch deep can be ignored. Nicks to a maximum depth of 0.005 inch must be blended out to remove sharp edges. Replace tubing with nicks greater than 0.005 inch deep.



MAXIMUM MATERIAL CONDITION

MINIMUM MATERIAL CONDITION

A – NOMINAL WELD – NO FINISHING REQUIRED



MAXIMUM MATERIAL CONDITION

MINIMUM MATERIAL CONDITION

B – FINISHED WELD – DIMENSIONS AFTER DRESSING

C2589A

Weld Repair - Inspection
Figure 601

(4) Dents - Round bottom dents on straight sections of tubing are permitted provided the length and depth are not greater than 10 percent of the normal outside diameter of tube. No more than one dent to maximum depth per 12 inch length of tube is acceptable. Dents on tube bends, which cause restriction by flattening and local weakening, are not acceptable.

(5) Pitting - Minor isolated pitting up to 0.003 inch deep is acceptable. Clusters of pitting should be blended out to a maximum depth of 0.005 inch. Tubing must be replaced if pitting exceeds 0.005 inch deep.

(6) Corrosion - Staining on tubing and surface corrosion is acceptable if removable by light polishing with crocus cloth and oil.

F. Inspection of Rotating Components

WARNING: LIFE LIMITED (CRITICAL) ROTATING COMPONENTS EXHIBITING CRACKS ARE UNSERVICEABLE AND SHALL NOT BE REPAIRED.

CAUTION: HANDLE ROTATING COMPONENTS WITH EXTREME CARE TO PREVENT DAMAGE OR CONTAMINATION OF THE MATERIAL.

CAUTION: WEAR LINT FREE GLOVES WHEN TOUCHING ROTATING COMPONENTS.

CAUTION: MAKE SURE CLOSE ATTENTION IS PAID TO AREAS SUCH AS COUNTERWEIGHT HOLES AND BLADE SLOTS WHERE IMPERFECTIONS ARE DIFFICULT TO FIND.

CAUTION: USE SUITABLE CLEAN, PROTECTIVE CONTAINERS FOR STORING AND TRANSPORTING COMPONENTS.

(1) Inspect components in accordance with the criteria specified in the relevant Chapter/Section/Subject.

(2) Any observed conditions not defined in this manual are not acceptable for repair.

(3) Evaluation of the surface should take into consideration the need for repairs and the limits to which repairs may be made to determine the suitability for continued use of the component.

(4) Unrepairable components shall be quarantined to prevent further use.

(5) It is important to have suitable lighting. The minimum recommended illumination for close and difficult inspection is 100 foot-candles measured at the inspection table top.

(6) Unless otherwise specified, magnification shall not be used. A magnification of 3X to 4X may be used as an aid to evaluate and confirm an observed condition in detail.

TABLE 601, Typical Physical Conditions

TERM	DESCRIPTION	USUAL CAUSES
ABRASION	A roughened area. Varying degrees of abrasion can be described as light or heavy depending upon the extent of repair necessary to restore the surface.	Presence of fine foreign material between moving surfaces.
BEND	General distortion in structure as distinguished from a local change in conformation such as a dent, peening, etc.	Forces as defined under STRESS, or uneven application of heat.
BLISTERING	Raised areas indicating separation of the surface from the base. Usually found on plated or painted surfaces.	Imperfect bond with the base, usually aggravated by the presence of moisture.
BREAK	Complete separation by force into two or more pieces.	Fatigue; shock or overload.
BRINELLING	Indentations sometimes found on the surface of ball or roller bearing parts.	Improper assembly or disassembly e.g. removing or installing a roller or ball bearing by force on the free race.
BURNING	Injury to the surfaces by excessive heat. Evidenced by characteristic discoloration or, in severe cases, by loss or flow of material.	Excessive heat due to lack of lubrication, improper clearance.
BURNISHING	Mechanical smoothing of a metal surface by rubbing not accompanied by removal of material but sometimes by discoloration around the outer edges of the area.	Normal operation of parts.
BURR	A sharp projection or rough edge.	Faulty machining operations, excessive wear, peening.
CHAFING	A rubbing action between two parts having limited relative motion.	
CHIPPING	Breaking out of small pieces of material.	Concentration of stress due to shock, nicks, scratches, inclusions, peening, etc., careless handling of parts.
CORROSION	Breakdown of the surface by chemical action.	Presence of corrosive agents.

TABLE 601, Typical Physical Conditions (Cont'd)

TERM	DESCRIPTION	USUAL CAUSES
CRACK	A partial fracture.	Excessive stress due to shock overloading, extension of a nick or scratch, or overheating.
DENT	Small, smoothly rounded hollow in the surface.	Concentrated overload resulting from peening or the pressure of chips between loaded surface; striking of part with dull object.
ELECTROLYTIC ACTION	Breakdown of the surface by electrolytic action between parts composed of dissimilar metals.	Galvanic action between dissimilar metals.
EROSION	Carrying away of material by the flow of grit, chemicals, or hot gasses.	Flow of corroding liquids or grit-laden oils.
FATIGUE	Progressive yielding of one or more local areas of weakness such as tool marks, cracks, or inclusions, under repeated stress. The progressive nature of the failure is usually indicated by several lines approximately concentric about a center, or "focus" which discloses the original point of failure.	Tool marks, sharp corners, nicks, cracks, inclusions, galling, corrosion, insufficient tightening of studs or bolts to obtain proper stretch.
FLAKING	Breaking away of pieces of a plated or painted surface.	Incomplete bond; excessive load, blistering.
FRETTING CORROSION	Discoloration may occur on surfaces which are pressed or bolted together under high pressure. On steel parts the color is reddish brown. On aluminum the oxide is white.	Rubbing off in fine particles of metal slight movement between parts and subsequent oxidizing of these particles.
GALLING	The transfer of metal from one surface to another.	Severe chafing or fretting action caused during engine operation by a slight relative movement of two surfaces under high contact pressure.
GLAZING	Development of a hard, glossy surface on bearing surfaces.	Combination of pressure oil and heat.

TABLE 601, Typical Physical Conditions (Cont'd)

TERM	DESCRIPTION	USUAL CAUSES
GOUGING	Displacement of material from a surface by a cutting, tearing or displacement effect.	Presence of a comparatively large foreign body between moving parts.
GROOVING	Smooth rounded furrows, such as score marks where sharp edges have been polished off.	Concentrated wear, abnormal relative motion of parts; parts out of alignment.
GUTTERING	Deep, concentrated erosion.	Enlargement of a crack or defect bu burning of an exhaust flame.
IMPERFECTION	An interruption (non-uniformity) in the normal surface condition of a part configuration which must be evaluated for acceptance to an assigned standard.	
INCLUSION	Foreign material enclosed in the metal. Surface inclusionsare indicated by dark spots or lines.	Inherent discontinuity in the material.
NICK	A sharp indentation caused by striking of one part against another metal object.	Carelessness in handling of parts or tools during, or prior to assembly; sand or fine foreign particles in the engine during operation.
PEENING	Deformation of the surface.	Impact of foreign object, such as occurs in repeated blows of a hammer on the part.
PICK-UP	Rolling up of metal, or transfer of metal from one surface to another.	Rubbing of two surfaces without sufficient lubrication; presence of grit between surfaces under pressure during assembly; unbroken edges of press fitted parts; incipient seizure of rotating parts during operations.
PILE-UP	Displacement of particles of a surface from one point to another.	

TABLE 601, Typical Physical Conditions (Cont'd)

TERM	DESCRIPTION	USUAL CAUSES
PITTING	Small, irregularly shaped cavities in a surface from which material has been removed by corrosion or chipping. Corrosive pitting is usually accompanied by a deposit formed by the action of a corrosive agent on the base material.	Corrosive pitting; breakdown of the surface by oxidation or some other chemical or electrolytic action.
PROFILE	The actual contour of a surface on a section perpendicular to that surface unless some other angle is specified.	
SCORING	Deep scratches made by sharp edges of foreign particles during engine operation; elongated gouges.	Presence of chips between loaded surfaces having a relative motion.
SCRATCHES	Narrow, shallow marks caused by the movement of a sharp object or particles across a surface.	Carelessness in handling of parts or tools prior to, or during, assembly; sand or fine foreign particles in engine during operation.
SMOOTH	A surface that is continuously even, free of irregularities, presenting no resistance to the sliding of a finger or spherical stylus. Can be applicable to a one plane surface or transition surfaces between planes.	
SPALLING	Sharply roughened area characteristic of the progressive chipping or peeling of surface material.	Surface crack, inclusion or similar surface injury causing a progressive breaking away of the surface under load.
STRESSES	When used in describing the cause of failure of machineparts, stresses are generally divided into three groups - compression, tension and shear. These are used to describe the forces as follows:	

TABLE 601, Typical Physical Conditions (Cont'd)

TERM	DESCRIPTION	USUAL CAUSES
	COMPRESSION - Action of two directly opposed forces which tend to squeeze a part together.	
	TENSION - Action of two directly opposed forces which tend to pull apart.	
	SHEAR - Action between two opposed parallel forces.	
SURFACE	The designed boundary, shape and extent of which is usually shown and dimensioned on an illustration	
TORSION	External twisting opposed by shear stress.	

STANDARD PRACTICES - CLEANING

1. General

   A. Gas turbine cleaning can be categorized into two broad areas: the cleaning of specific parts and engine cleaning in the field (compressor washing).

   B. Individual parts are cleaned primarily to remove contaminants which might conceal minor cracks and other damage which, if not detected, could eventually lead to component or part becoming unserviceable. Engine components or parts should be cleaned only as necessary to perform required inspection and repair. Excessive cleaning of components or parts is unnecessary and should be avoided. The cleaning methods in the following text are adequate for all maintenance levels.

   C. For compressor washing methods, refer to Chapter 71-00-00, CLEANING.

2. Consumable Materials

   Not Applicable

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Cleaning

   A. General Precautions

      (1) Prior to engine disassembly, ensure that the work area is clean.

      (2) Benches on which engine parts are placed must be clean and free from grit, metal filings, etc., which may contaminate engine oil systems, fuel systems or hardware.

      (3) Clean plastic bags should be available in which oil system and fuel system parts may be stored until ready for reassembly.

      (4) Clean plastic caps or covers should be used to protect exposed tubes or bearing areas.

      (5) At reassembly ensure that all parts are clean and new packings installed.

   B. Cleaning Precautions

      NOTE: The choice of cleaning agents should be limited to consumables listed in 72-00-00, MAINTENANCE PRACTICES, Table 203. The toxicity of cleansing agent will, however, depend on the type of contamination encountered on part to be cleaned.

CAUTION: TAKE PARTICULAR CARE IN SELECTING CLEANING METHOD TO ENSURE THAT ANODIZING AND OTHER PROTECTIVE COATINGS ARE NOT REMOVED FROM PARENT METAL. DO NOT USE ALKALIES ON ALUMINUM, MAGNESIUM, ALUMINIZED AND PAINTED AREAS.

(1) Wear rubber gloves, apron or coveralls and face shield or goggles, when working with solvents.

(2) Use the least toxic of available cleaning materials which will satisfactorily accomplish work.

(3) Perform all cleaning operations in a well ventilated work area.

(4) Ensure that adequate and usable fire fighting and safety equipment is conveniently located and available to all personnel.

(5) Do not smoke or expose a flame within 50 feet of cleaning area.

(6) Ensure that all degreasing agents are thoroughly removed from all parts after cleaning.

(7) Do not use steel brushes for any cleaning operation except when specifically detailed within this manual. Use a stiff bristle fiber brush.

C. Cleaning Before Welding

(1) Surface to be welded must be free from protective coatings, dirt, grease, oil and other contaminants, and as free as possible from oxide formation. Wire brushes and abrasives may be used to remove protective coatings and oxides, except that the final step in removing oxides from aluminum alloys preferably should consist of chemical treatment immediately prior to welding. Wire brushes, when used for cleaning corrosion-resistant alloy, must have bristles of austenitic, corrosion-resistant steel. No undesirable deposit or residue must remain on surface to be welded after cleaning operation.

STANDARD PRACTICES - REPAIR

1. General

   A. The primary purpose of repair is to enable a component or engine part to be reworked to a condition which will provide safe operation. Approved general repair schemes are detailed in this section. Specialized repairs for other engine components can be found in the applicable chapters of this manual.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Engine Oil
PWC05-061	Crocus Cloth
PWC05-100	Abrasive Stone
PWC05-157	Welding Electrode
PWC05-161	Chrome Pickle Solution
PWC05-197	Chromic Acid Flakes
PWC11-014	Isopropyl Alcohol

3. Special Tools

   The special tools listed below are used in the following procedures.

Tool No.	Name
PWC31771	Shank Nut Spreader

4. Fixtures, Equipment and Supplier Tools

   The fixtures, equipment and supplier tools listed below are used in the following procedures.

Name	Remarks
Arc Welding Machine	Ref. 72-00-50, Maintenance Practices, Table 202
Argon Gas Regulator	Ref. 72-00-50, Maintenance Practices, Table 202
Flowmeter (qty. 2)	Ref. 72-00-50, Maintenance Practices, Table 202
Shielded Arc Torch	Ref. 72-00-50, Maintenance Practices, Table 202

5. Welding Repairs

A. General

(1) A tungsten inert gas fusion welding process must be used when repairing cracks in engine parts. Argon or helium gas may be used in inert gas welding; however, argon is recommended by Pratt & Whitney Canada because its greater density reduces its rate of diffusion with the atmosphere.

(2) Inert gas welding is a gas arc welding process which uses inert gas to protect the weld area from the surrounding atmosphere. The heat necessary for welding is provided by a very intense electric arc which is struck between a non-consumable thoriated tungsten (tungsten and thorium alloy) electrode and the metal part. On repairs where a filler material is required, an appropriate welding rod is fed into the weld area and melted with the base metal in the same manner as in conventional gas welding.

B. Welding Equipment

(1) The following equipment is required for the inert gas welding process:

(a) An AC/DC arc welder with high frequency controls (Ref. 72-00-50, Table 202, item 3)

(b) A shielded arc torch (item 6), or equivalent, with circulating water equipment, and ceramic cups of suitable size.

WARNING: IF AN OXYGEN REGULATOR IS USED WITH ARGON GAS, DO NOT REINSTALL REGULATOR ON AN OXYGEN CYLINDER. ARGON GAS IS NOT FREE FROM OIL AND THE POSSIBILITY EXISTS OF AN EXPLOSION CAUSED BY PRESENCE OF OIL IN THE REGULATOR.

(c) An argon gas regulator (item 4).

(d) Two flowmeters (item 5).

C. Cleaning Before Welding

(1) Refer to STANDARD PRACTICES- CLEANING.

D. Welding Procedures

(1) Welding must be carried out only by certified personnel.

(a) Connect one argon gas flowmeter to torch and connect other flowmeter, if necessary, behind crack as a backup when ready to weld.

(b) Connect torch to arc welder for straight polarity.

(c) Insert a 1/16 inch diameter thoriated tungsten electrode (PWC05-157) into torch, allowing approximately 5/16 inch of electrode to protrude from ceramic cup. The ceramic cup used must not be smaller than a No. 6 for the shielded arc torch (72-00-00, Table 202, item 6), in order to provide a sufficient amount of inert gas to the weld area where cleanliness of the surface beads is important.

NOTE: A plain tungsten electrode may be used, but a needle point must be maintained on the electrode for more positive starting of arc. Where possible, the electrode must be kept clean of material pickup.

(d) If it is necessary to protect underside of weld from contamination, possible weld porosity, or poor surface finish, attach argon gas line behind crack to be welded. This may be accomplished by fabrication of small box-like fixtures having edges shaped to fit contours of part to be welded and using a suitable connection to secure gas line. Seal fixture to part in order to conserve gas leakage to minimum.

NOTE: The amount of gas pressure to provide sufficient backup must be determined. This pressure should not allow the gas to stir the weld puddle. Do not use flux when welding in an inert atmosphere.

(e) When high frequency controls are used, it is not necessary to strike an arc. Hold torch vertically to work so that the shielding gas (argon) forms a protective envelope around the weld. It is preferable to have area to be welded in a horizontal position.

(f) When high frequency controls are not used, strike arc and hold electrode tip approximately 1/8 to 1/4 inch above surface to be welded until a puddle is formed. Add welding rod, as applicable, and proceed as in conventional gas welding.

NOTE: Test welds, using corresponding material of same thickness and joint design, should be made to determine correct gas pressure and arc welding settings.

(g) Because a high percentage of steel parts used in the engine are fabricated from 12 percent chromium corrosion-resistant steels, which are characterized by their susceptibility to air hardening, field repair of cracks by fusion welding is a special problem. The high temperature at which fusion weld repairs are made and the subsequent air cooling of the part, or parts, from these temperatures usually results in an increase in material hardness and a loss in ductility. Parts on which fusion weld repairs have been made have a tendency to crack because the steel structure becomes unstable, brittle and highly stressed. The structure of the material can be improved by reheating the parts and controlling the cooling rate.

E. Cleaning After Welding

(1) Refer to STANDARD PRACTICES - CLEANING

F. Local Stress Relief

(1) Components which are not highly stressed may be repaired by fusion welding. It is possible to partially restore the original properties of such welded parts through use of local heat treatment. The localized heat may be applied by neutral flame of an oxyacetylene torch. Extend the stress relief one inch minimum beyond the welded area. After the desired heat has been applied to the part for the correct length of time, reduce temperature of part gradually.

G. Inspection of Welding

(1) Refer to STANDARD PRACTICES - INSPECTION.

H. Blend Repair Procedure

(1) DELETED

6. Blend Repairs

A. Blend Repair Procedure

(1) Blend repair using carborundum stones (PWC05-100).

(2) Polish blended area using crocus cloth (PWC05-061).

CAUTION: DO NOT POLISH WITH POWER TOOLS.

(3) Blend all repairs and finish smoothly.

(4) Lines, scratches, or sharp edges which may cause a concentration of stress are not permitted.

7. Helical Coil Inserts

A. Replacement of Helical Coil Inserts

CAUTION: BEFORE INSTALLING HELICAL COIL INSERTS, REFER TO ILLUSTRATED PARTS CATALOG, P&WC MANUAL P/N 3033444, FOR APPROVED LOCATIONS AND PART NUMBERS.

(1) Remove damaged insert using an approved extraction tool.

(2) Clean out hole and ensure swarf and other foreign matter is removed.

(3) Using new helical coil insert, install insert into threaded hole using insert installation tool. Insert outer thread must be between one and one-half threads below surface of hole or counterbore, whichever applies.

(4) Cut off driving tang at notch using approved tang removal tool and remove tang from holes.

(5) Inspect repaired hole.

8. Studs

A. Replacement of Studs

(1) General

(a) When necessary, oversize studs are to be installed in place of those which are broken, stretched, loose or have damaged external threads. Whenever a stud which is already oversize requires replacement, install the next oversize stud. Use correct stud drivers to install new studs and torque to appropriate value (Ref. Tables 801 or 802, as applicable).

TABLE 801, Standard Stud Torque Limits

Stud Thread Size (Drive End)	Minimum	Maximum Necked Down $	Maximum Plain #
0.112-40	4	-	8
0.138-32	8	-	14
0.164-32	10	30	30
0.190-24	15	40	45
0.216-24	20	65	70
0.250-20	40	95	105
0.3125-18	85	210	230
0.375-16	160	375	425
0.4375-14	200	600	675
0.500-13	250	950	1050

NOTE: 1. Symbol $: These limits apply where the unthreaded diameter of the stud is less than the minimum minor diameter of the coarse pitch thread (drive end).

NOTE: 2. Symbol #: These limits apply where the unthreaded diameter of the stud is equal to or greater than the minimum minor diameter of the coarse pitch thread (drive end).

TABLE 802, Stepped Stud Torque Limits

Stud Thread Size (Nut End)	Minimum	Maximum Necked Down $	Maximum Plain #
0.138-40	8	-	18
0.164-36	10	30	30
0.190-32	15	45	50

TABLE 802, Stepped Stud Torque Limits (Cont'd)

Stud Thread Size (Nut End)	Minimum	Maximum Necked Down $	Maximum Plain #
0.216-28	20	65	75
0.250-28	40	115	125
0.3125-24	85	240	260
0.375-24	160	450	500
0.4375-20	200	700	800
0.500-20	250	1150	1300

NOTE: 1. Symbol $: These limits apply where the unthreaded diameter of the stud is less than the minimum minor diameter of the fine pitch thread (nut end).

NOTE: 2. Symbol #: These limits apply where the unthreaded diameter of the stud is equal to or greater than the minimum minor diameter of the fine pitch thread (nut end).

CAUTION: BEFORE INSTALLING NEW STUDS, REFER TO ILLUSTRATED PARTS CATALOG, P&WC P/N 3033444 FOR APPROVED LOCATIONS AND PART NUMBERS.

(b) Stud holes with threads damaged beyond dimensions suitable for fitting a maximum oversize stud are usually possible to repair by installing a helical coil or key-type insert (Ref. Para. A.). Consideration should, however, be given to reduction of thickness of walls or parent metal around insert and the required strength. Specific problems should be referred to P&WC Customer Support Department (Ref. INTRODUCTION).

(2) Replacement of a Damaged Stud

(a) Remove damaged stud using an approved method.

(b) Examine stud hole for condition; on worn stud holes use oversize studs.

(c) Install stud using an approved stud driver to correct protrusion height; ensure torque limits (Ref. Tables 801 or 802, as applicable) are not exceeded.

B. Repair of Damaged Stud Hole

(1) Ensure damaged hole is suitable for repair in accordance with Subpara. A. preceding.

(2) Measure core depth of existing hole.

(3) Select relevant size drill and drill hole to depth measured in step (2), preceding.

(4) Using relevant special tap, thread hole one thread deeper then insert to be fitted.

(5) Where applicable, counterbore hole to required angle and depth.

(6) Clean out hole and ensure freedom from metal chips and other foreign matter.

(7) If stud hole being repaired is in a magnesium alloy component, treat tapped hole with chrome pickle solution (PWC05-161) before installing replacement stud as follows:

(a) Clean area to be treated with crocus cloth (PWC05-061) and/or cloth impregnated with isopropyl alcohol (PWC11-014).

(b) On rough surfaces, remove corrosion using wire brush or abrasive paper.

(c) On finished surfaces, remove corrosion using swab or brush impregnated with hot chromic acid solution (PWC05-197) at 180° to 200°F.

(d) Rinse with clean cold water.

(e) Rinse with clean hot water.

(f) Dry using clean, dry compressed air.

(g) Apply chromic acid solution (PWC05-197) for 30 to 45 secondsto area to be treated using a clean cloth. Repeat swabbing at frequent intervals to ensure treated area is maintained wet with solution during treatment.

(h) Thoroughly rinse touched up area by swabbing several times with clean cloth moistened with water.

(i) Dry using clean, dry compressed air.

(8) Install appropriately sized helical coil insert into repaired stud hole (Ref. Para. A.).

9. Corrosion Treatment

A. Magnesium Alloy Components

(1) Clean area to be treated with crocus cloth (PWC05-061) and/or cloth impregnated with isopropyl alcohol (PWC11-014).

(2) On rough surfaces, remove corrosion using wire brush or abrasive paper.

(3) On finished surfaces, remove corrosion using a swab or a brush impregnated with hot chromic acid solution. Prepare solution as follows:

(a) Fill an appropriate container to one half of it's volume with distilled water.

(b) Heat the distilled water to 120° to 140°F.

(c) Add chromic acid flakes (PWC05-197) to the heated water in the following proportion: 24 oz. by weight per 1 US gallon, or 29 oz. by weight per 1 imperial gallon. Stir the solution to dissolve the flakes in solution.

(d) Fill the remaining volume of the container with distilled water and stir to dissolve the solution.

(4) Rinse with clean cold water.

(5) Rinse with clean hot water.

(6) Dry using clean, dry compressed air.

(7) Apply prepared chromic acid solution to area to be treated using a clean cloth. Repeat swabbing at frequent intervals to ensure treated area is kept wet with solution during treatment.

(8) Thoroughly rinse touched up area by swabbing several times with clean cloth moistened with water.

(9) Dry using clean, dry compressed air.

(10) Store unused chromic acid solution in a suitable dark bottle and mark the bottle with date of creation. The prepared solution's shelf life shall be two years.

10. Shanknuts

A. Replacement (Ref. Fig. 801)

CAUTION: AVOID DAMAGE TO FLANGE.

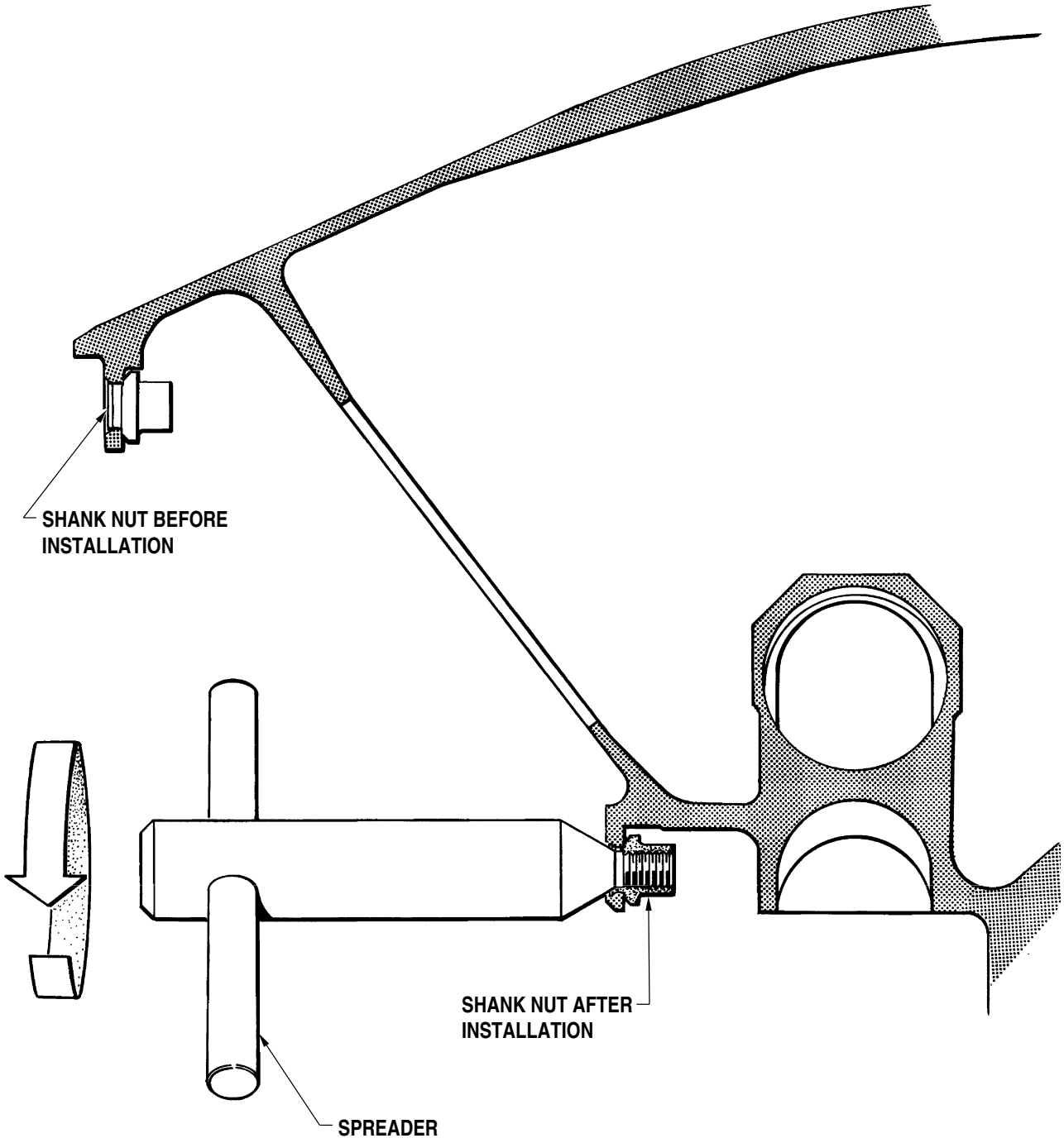
(1) Using a suitable drill, partially remove the flared end of shanknut.

(2) Use a parallel pin punch at drilled end to shear weakened flare. Remove and recover shanknut.

(3) Install new shanknut and hold against flange.

(4) Lightly lubricate tapered portion of spreader (PWC31771) with engine oil (PWC03-001) and screw into shanknut until shank end is flared against flange.

(5) Remove shanknut spreader (PWC31771) and examine flared end of shanknut for correct formation with no evidence of deformation or cracks.



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Shanknut Replacement
Figure 801

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
LEP	1	Apr 04/2016
	2	Apr 04/2016
Contents	1	Apr 04/2016
	2	Apr 04/2016
	3	Apr 04/2016
	4	Apr 04/2016
71-00-00	501	Apr 04/2016
Adjustment/	502	Apr 04/2016
Test	503	Apr 04/2016
	504	Apr 04/2016
	505	Apr 04/2016
	506	Apr 04/2016
	507	Apr 04/2016
	508	Apr 04/2016
	509	Apr 04/2016
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	571	Apr 04/2016
	572	Apr 04/2016

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LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
71-00-00	701	Nov 10/2014
Cleaning/	702	Nov 10/2014
Painting	703	Nov 10/2014
	704	Nov 10/2014
	705	Nov 10/2014
	706	Nov 10/2014
	707	Nov 10/2014
	708	Nov 10/2014
	709	Nov 10/2014
	710	Nov 10/2014
	711	Nov 10/2014
	712 blank	Nov 10/2014

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TABLE OF CONTENTS

SUBJECT	PAGE
POWER PLANT - ADJUSTMENT/TEST	**71-00-00**
1. General	501
2. Consumable Materials	501
3. Special Tools	501
4. Fixtures, Equipment and Supplier Tools	501
5. Introduction	503
6. Ground Safety Precautions	503
A. General	503
B. Air Intake Area - Engine Running	503
C. Exhaust Jet Wake Area - Engine Running	503
D. Cool Down	505
E. Jet Fuel and Lubricating Oil	505
7. Test Information	505
A. General	505
B. Symbols	505
C. Instrument Accuracy	505
8. Engine Operating Limits	506
9. Engine Data Plate Information	507
10. Engine Overtemperature Condition	508
11. Engine Overspeed Condition	510
12. Foreign Object Damage (FOD)	510
13. EEC Reversion	515
A. Engine Electronic Control (EEC) Reversion	515
14. Fuel	515
15. Precipitation	515
16. Fuel Manifold Pressure Checks - Recommendations	515

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
POWER PLANT - ADJUSTMENT/TEST (Cont'd)	**71-00-00**
A. General	515
B. Secondary Fuel Manifold Pressure Check	516
C. Primary Fuel Manifold Pressure Check	516
17. Extreme Weather Conditions	517
A. Cold Weather Procedures	517
B. Hot Weather Procedures	517
18. Ground Testing	518
19. Engine Ground Checks	519
A. Check No. 1 - Premotoring or Prestart	519
B. Dry Motoring Run	519
C. Wet Motoring Run	520
D. Emergency - Ground Engine Fire	521
E. Check No. 2 - Engine Start	521
F. Check No. 3 - Engine Shutdown	523
G. Check No.4 - Engine Calibration	524
H. Check No. 5 - Engine Performance	528
I. Check No.6 - EEC Authority	530
J. Check No.7 - Minimum Fuel Flow	535
K. Check No. 8 - Secondary Fuel Manifold Pressure Check JT15D-5 (Pre-SB7493 and Pre-SB7526)	537
L. Primary Fuel Manifold Pressure Check	544
M. Check No.9 - N1 Takeoff Thrust Check	546
N. Check 10 - Fuel Pump Inlet Screen Check	549
20. On-Aircraft Engine Vibration Analysis and Trim Balance	549
A. General	549

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
POWER PLANT - ADJUSTMENT/TEST (Cont'd)	**71-00-00**
21. On Aircraft Engine Vibration Analysis and Trim Balance using ACES Model 1700 Equipment	550
A. Check Engine LP Compressor Trim Balance Weight Configuration	550
B. Installation of ACES Model 1700 Equipment	552
C. Check ACES Model 1700 Battery Charge	559
D. Reviewing, Storing and Compressing Previous Vibration Surveys	559
E. Engine Vibration Survey: ACES Model 1700	560
F. Reference Fan Trim Balancing Run: ACES Model 1700	562
G. Trial Counterweight Fan Trim Balance Run: ACES Model 1700	565
H. Final Trim Counterweight Fan Balance Run: ACES Model 1700	566
I. Review Trim Balance Results	567
J. Removal of Test Equipment	567
22. Use of Chadwick-Helmuth Model 8500 Equipment	568
A. On Aircraft Engine Vibration Analysis and Trim Balance - Chadwick-Helmuth Model 8500	568
POWER PLANT - CLEANING	**71-00-00**
1. General	701
2. Consumable Materials	701
3. Special Tools	701
4. Fixtures, Equipment and Supplier Tools	701
5. Cleaning Procedures	701
A. General	701
B. Recommended Wash Methods and Intervals	702
6. Engine External Wash	703
A. Engine External Wash	703

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
POWER PLANT - CLEANING (Cont'd)	**71-00-00**
7. Engine Preparation	703
A. Procedure	703
B. Preparation of Equipment	704
8. Fan Washing	704
A. Procedure	704
9. Compressor Desalination Wash	706
A. Compressor Desalination Motoring Wash	706
10. Turbine Washing	707
A. Procedure	707
11. Post-Wash Procedures	709
A. Procedure	709
12. Inhibition of Engine Corrosion	710
A. Optional On-aircraft Internal Application of Engine Corrosion-inhibiting Solution	710
B. Optional On-aircraft External Application of Engine Corrosion-inhibiting Solution	711

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The export control classification with respect to this document is contained on the back of the title page.

POWER PLANT - ADJUSTMENT/TEST

1. General

A. The following information and procedures are for testing the engine and making adjustments to engine components.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC04-001	General Purpose Grease
PWC05-007	Leak Checking Fluid
PWC05-089	Lockwire
PWC05-238	Front Projection Material
PWC05-257	Reflective Patches
PWC11-010D	Methyl Alcohol
PWC11-014	Isopropyl Alcohol
PWC11-042	Citrus Based Cleaner

3. Special Tools

The special tools listed below are used in the following procedures.

Tool No.	Name
PWC52092	Adapter, Vibration Transducer
PWC52161	Fuel Manifold Pressure Gage

4. Fixtures, Equipment and Supplier Tools

The fixtures, equipment and supplier tools listed below are used in the following procedures. For supplier information, refer to Special Fixtures and Equipment Table in 72-00-00, MAINTENANCE PRACTICES.

Name	Remarks
ACES Collector Analyzer Plus, Model 1700	Z1700-110V
ACES JT15D RAM Procedure Card (Version 2.50 or later)	75-200-001
ACES Phototach Optical Tachometer	10-100-1773
Mounting Bracket, Phototach Tachometer	22-430-0058
ACES Lasetach Optical Tachometer	10-100-1300
Mounting Bracket, Lasetach Tachometer	10-100-0196
Charge Converter, Model 530	10-100-0574
Speed Conditioning Unit (SCU), Model 517P	10-100-0485
Velocity Sensor	69-100-0016

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Name	Remarks
Cable, High Temperature , Velocity Sensor-to-Charge Converter	10-320-0008
Cable, Charge Converter-to-Analyzer	10-320-0131
Cable, Optical Probe-to-Speed Conditioning Unit, 50 ft.	10-320-0126
Cable, COMM, SCU-to-Analyzer	10-320-0180
Cable, TACH, SCU-to-Analyzer	10-320-0181
Cable Assembly, N2 Rotational Speed	10-320-0178
Cable Assembly, N1 Rotational Speed	10-320-0179 (required for optional vibration survey procedure)
Extension Cable, N1 Speed-to-Speed Conditioning Unit	10-320-0169 (required for optional vibration survey procedure)
Extension Cable, N2 Speed Cable-to-Speed Conditioning Unit	10-320-0171
Vibration Analyzer	Chadwick-Helmuth No. 8500
Signal Selector or Switch Box	P/N 11130-1
Velocimeter	P/N 7310
Velocimeter Cable (50 ft.)	P/N11210-50
Velocimeter Bracket	P/N 6752
Photoprobe Bracket	P/N 7194-1
Photoprobe Bracket	P/N 10423-1
Photoprobe	P/N 10200-1
Photoprobe Cable	P/N 10185-50
Photocell Processor	P/N 10170-1
Adapter Cable (dc)	P/N 3140-9
Balancer Input Cable	P/N 8998
Connector Cable, Analyzer-to-Signal Selector	P/N 10811-12
Power Cable, Signal Selector	P/N 10813-12
JT15D-5 LP Compressor Balance Chart Disk	P/N 10055

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5. Introduction

This section contains information for engine ground run tests and for checks and adjustment/test procedures to verify integrity of aninstalled/replaced item. Precautions are given for safety of personnel and avoidance of engine damage and should be observed (together with appropriate precautions listed in the relevant airframe manufacturer's manual) before and during engine ground running. Detailed information is given on engine test data, Ground Operating Limits and procedures to follow after engine overtemperature or rotor overspeed.

The operating procedures contained in this section are based on Pratt & Whitney Canada supplied items; no attempt has been made to address airframe supplied items for the many possible variations in installations. Likewise, the performance curves are based on the uninstalled engine. Therefore, for up-to-date technical accuracy and performance checks, the power plant section of the applicable Airframe Maintenance Manual takes precedence and reference must be made to it.

6. Ground Safety Precautions

A. General

Great care must be taken when handling or working on turbine powered aircraft to avoid injury to personnel and damage to property and engine. Areas of extreme danger are the air intake and exhaust jet wake (Ref. Fig. 501).

B. Air Intake Area - Engine Running

The air intake is capable of generating sufficient suction to pull a person partially into the intake duct. The potential danger of this suction cannot be overemphasized; in an idling engine it may be sufficient to cause ingestion of eyeglasses, small tools, rags or other small objects.

C. Exhaust Jet Wake Area - Engine Running

The exhaust jet wake must be approached with extreme caution as extensive damage can be incurred from the high temperature, high velocity gases. At high engine speeds, the jet wake may propel loose dirt, sizeable stones, sand and debris over a considerable distance. The high temperatures in the wake are sufficient to deteriorate asphalt, and for this reason concrete is recommended for run-up areas.

Occasionally, when starting a jet engine, an accumulation of fuel in the exhaust tail pipe is blown out as long streams of flame. Personnel should observe proper fire precautions and move all flammable material to a safe distance.

Exposure to gases in the jet wake should be avoided. Failure to do so may result in respiratory irritations and a burning sensation in the eyes. Particular care should be taken to avoid exposure to gases in confined spaces where the gas concentration may be high.

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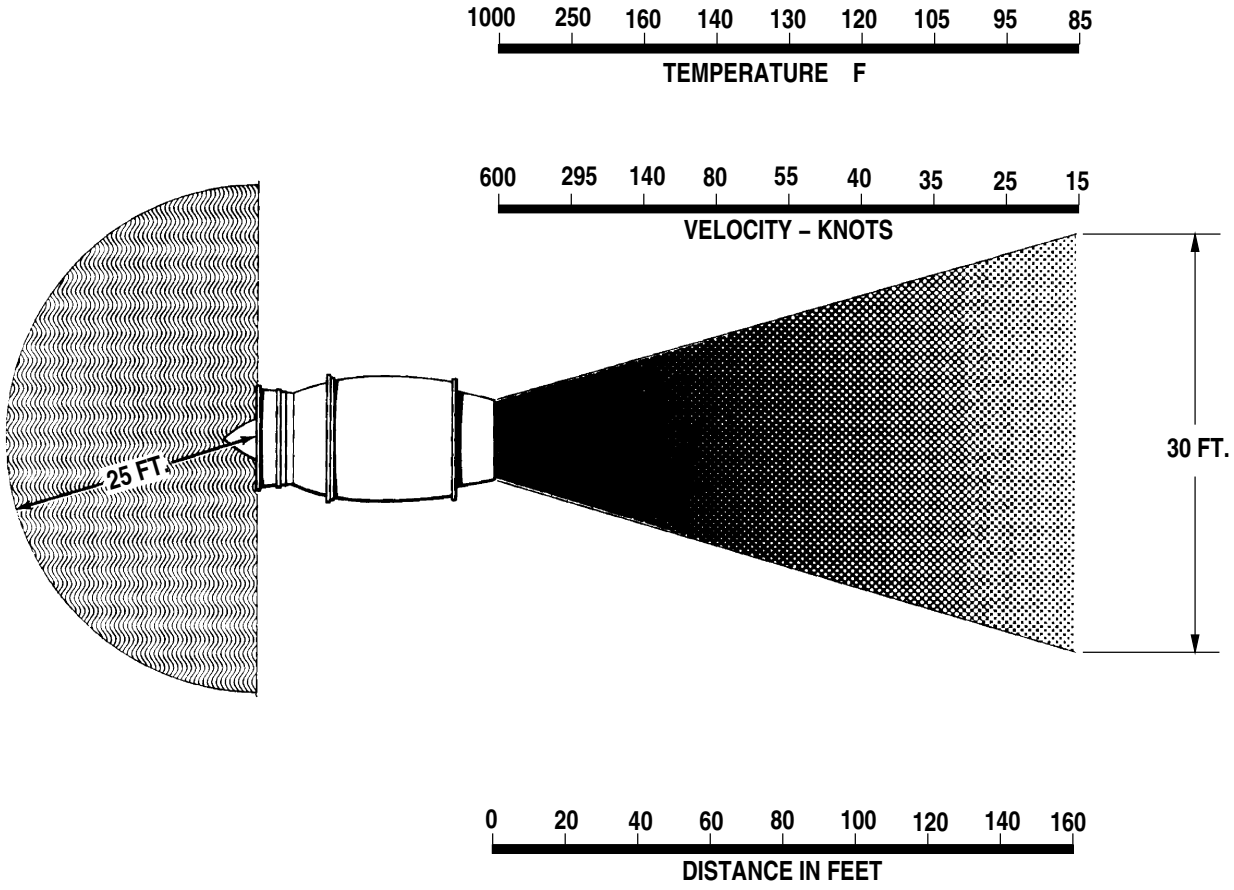

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Air Intake and Exhaust Jet Wake Danger Areas
Figure 501

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D. Cool Down

After engine operation, work that requires contact with the exhaust tailpipe should not be carried out for at least one-half hour. Heat-resistant gloves must be worn, if work in this area is required immediately after shutdown.

E. Jet Fuel and Lubricating Oil

All jet fuels and lubricating oils are injurious to the skin. Precautions must be taken to avoid contact as much as possible.

7. Test Information

A. General

The performance of a turbine engine is greatly affected by surrounding atmospheric conditions. For this reason, it is essential that accurate values of ambient temperatures are obtained for the immediate area at the time of engine testing. Furthermore, it is highly desirable to carry out engine trimming and performance checks at low wind velocity with the engine intake facing into the wind. Even this precaution will not prevent an unstable trim in certain aircraft at moderate-to-high wind velocities. Each type of aircraft must have special procedures and limits set up for trimming the engine when the wind velocity and direction exceed those in which a stable trim can be obtained (refer to Aircraft Manufacturer's Manual).

B. Symbols

Symbols have been designated for the working variables used in connection with engine testing. The symbols, referenced to various stations within the engine, and their meanings are described as follows:

Pam	Ambient Pressure
tam	Ambient Temperature
T5	Interturbine Temperature
Wf	Fuel Flow
N1	Low Rotor rpm
N2	High Rotor rpm
Δ Psd	Bypass Static minus Inlet Total Pressure
θ	T observed/T standard
δ	P observed/P standard
Toil	Oil Temperature
Poil	Oil Pressure

NOTE: θ and δ are ratios of absolute values.

C. Instrument Accuracy

Due to the fact that even the best instrumentation available can vary with use, it is recommended that instrumentation used in engine testing be calibrated every 30 days, or as dictated by experience. Instrument accuracy should be within the following limits:

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Pam	± 0.05 in.Hg
tam	± 1°C
T5	± 5°C (System accuracy)
Wf	± 25 lb/hr
N1	± 0.5%
N2	± 0.5%
Toil	± 3°C (normal operating range)
Poil	± 2 psi (full range)
Δ Psd	0.05 psi

8. Engine Operating Limits

The limits shown in 501 are provided as a guide and are based on specified sea level and ambient temperatures (Ref. 72-00-00, DESCRIPTION AND OPERATION, Engine Data).

TABLE 501, Engine Ground Operating Limits

Thrust Setting	Time Limit (Minutes)	Max. Obsd. Turb. Temp.°C	N2		N1		Oil Press. (4)		Oil Temp. °F
			RPM	%	RPM	%	psig	kPa	
Takeoff (3)	5	700	31450	96	16540	104	60 to 83	414 to 572	50 to 250
Max. Continuous (5)	Con-tinuous	680	31450	96	16540	104	60 to 83	414 to 572	50 to 250
Ground Idle	Con-tinuous		15069 (Min.)	46			40 (Min.)		-40 to 250
Flight Idle	Con-tinuous	580	17035 (Min.)	52 (Min.)			40 (Min.)	276 (Min.)	-40 to 250
Starting		(Ref. Fig. 503)							-40 Min.
Transient		720 (Ref. Fig. 504)	31450	96	16860 (Ref. Fig. 505)	106	95 (7)	655 (7)	275 for 15 mins. at Max. Con-tinuous or below

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TABLE 501, Engine Ground Operating Limits (Cont'd)

Thrust Setting	Time Limit (Minutes)	Max. Obsd. Turb. Temp.°C	N2		N1		Oil Press. (4)		Oil Temp. °F
			RPM	%	RPM	%	psig	kPa	
NOTE: 1. For approved oil refer to engine Service Bulletin No. 7001 (latest revision).									
NOTE: 2. For approved fuels and additives refer to SB7144 (latest revision). If fuel in accordance with Service Bulletin No. 7144 is not available, aviation gasoline MIL-G-5572, all grades, may be used for a maximum of 50 hours between overhauls. The use of an alternative fuel may necessitate adjustment of the pressure regulating valve on the HMU to compensate for fuel density change. Refer to Flight Manual under heading, "LIMITATIONS AND ADJUSTMENTS".									
NOTE: 3. The total time during which takeoff thrust may be used is limited to 5 minutes, the time limit to commence when Power Lever is first advanced for T/O thrust.									
NOTE: 4. Normal oil pressure is 60 to 83 psig (414 to 572 KPa gauge) at N2 speeds above 60%. Oil pressure below 60 psig (414 KPa gauge) is undesirable and should be tolerated only for the completion of the flight, preferably, at reduced power setting. Oil pressure below 40 psig (276 KPa gauge) is unsafe and requires that either the engine be shut down or a landing be made as soon as possible, using the minimum power required to sustain flight. Under certain cold starting conditions oil pressure can reach 150 psig (1034 KPa gauge).									
NOTE: 5. Maximum continuous rating is the maximum thrust that may be used continuously and corresponds to 2900 pounds at sea level up to 15°C (59°F) ambient temperature. Maximum continuous is an emergency rating only.									
NOTE: 6. Climb and cruise - refer to appropriate section of Aircraft Flight Manual.									
NOTE: 7. Time limited to one and one half (1 ½) minutes.									

9. Engine Data Plate Information

The following information is contained on the engine data plate located on the bottom surface of the accessories gearbox (Ref. Fig. 502):

A. Engine Serial No.

B. Build Specification No. 636 : P&WC engine hardware configuration

C. H: These blocks provide trim balance counterweight plane, class and rivet hole location codes for the HP turbine. Location codes for the front (F) and rear (R) disk balance rims are relative to the disk datum index mark. If the HP turbine is to be replaced, transfer the trim balance weights to the new disk (Ref. 72-50-02).

D. L: This block provides trim balance counterweight class and rivet hole location codes for the LP compressor (fan). Location codes are relative to the fan hub index mark. If the fan is to be replaced, transfer the trim balance weights to the new fan (Ref. 72-30-03).

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E. N1%: Low compressor rotor speed (normalized to a standard day) in percent when the engine is running in test cell at reference thrust of 2900 lb. The N1 speed is used to obtain engine exhaust nozzle class (Ref. Airframe Maintenance Manual).

F. N2%: HP turbine speed (normalized to a standard day) in percent when the engine is running in test cell at reference thrust of 2900 lb.

G. FN/δ 2900: Engine Reference Thrust in lb.

H. Trim Plug: This block provides the trim plug class number. The trim plug class relates to a specific N1% rpm value. This value is selected at engine final acceptance test to bias the signal to the EEC so that all engines provide the same thrust as a function of power lever angle and ambient temperature.

I. T5 Trim: Value in ohms of variable resistor installed at junction of T1 and T6 thermocouple wiring harnesses (Ref. 77-00-01)

10. Engine Overtemperature Condition

Overtemperature conditions are usually preceded by an excessively rapid rise in fuel flow, N2 and N1 speeds, and turbine temperature. Several momentary high overtemperatures affect engine service life just as seriously as a single prolonged lower overtemperature condition. The higher the temperature the sooner serious engine damage occurs. When an engine overtemperature condition is anticipated, or has occurred, perform a normal engine shutdown. Avoid an emergency shutdown unless it is obvious that continued operation will result in more than overtemperature damage. For overtemperature limits and corresponding inspection procedures, refer to Figures 503 and 504.

The figures for Overtemperature Limits are prepared in degrees Centigrade (°C). If degrees Fahrenheit (°F) are required, refer to the conversion listing in Table 502, following.

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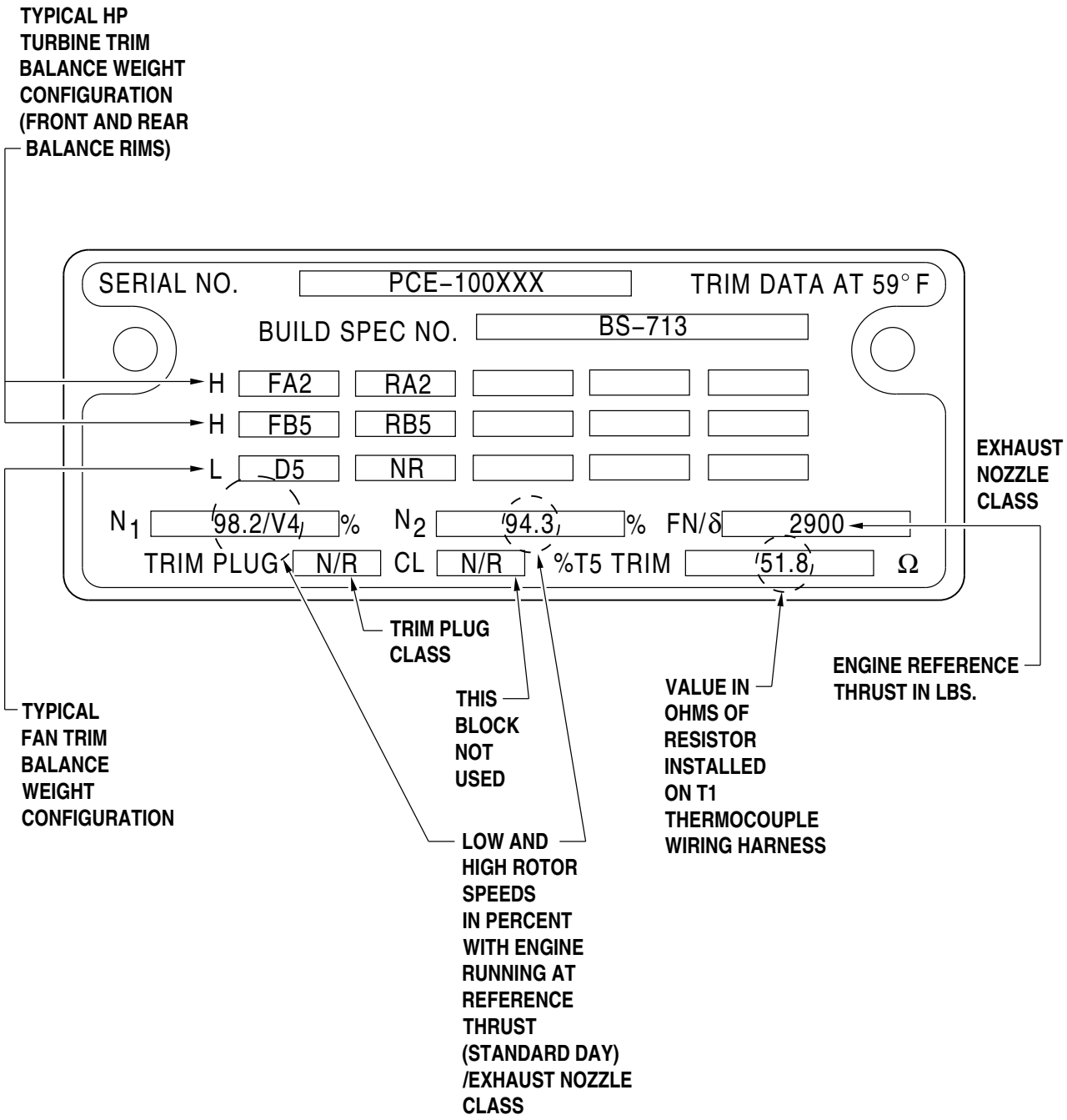
TYPICAL HP TURBINE TRIM BALANCE WEIGHT CONFIGURATION (FRONT AND REAR BALANCE RIMS)
SERIAL NO.
PCE–100XXX
TRIM DATA AT 59° F
BUILD SPEC NO.
BS–713
H FA2 RA2
H FB5 RB5
L D5 NR
N1 98.2/V4 %
N2 94.3 %
FN/δ 2900
TRIM PLUG N/R
CL N/R
%T5 TRIM 51.8 Ω
EXHAUST NOZZLE CLASS
TRIM PLUG CLASS
ENGINE REFERENCE THRUST IN LBS.
TYPICAL FAN TRIM BALANCE WEIGHT CONFIGURATION
THIS BLOCK NOT USED
VALUE IN OHMS OF RESISTOR INSTALLED ON T1 THERMOCOUPLE WIRING HARNESS
LOW AND HIGH ROTOR SPEEDS IN PERCENT WITH ENGINE RUNNING AT REFERENCE THRUST (STANDARD DAY) /EXHAUST NOZZLE CLASS

C179450

Engine Trim Data Plate - Example
Figure 502

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TABLE 502, Conversion Chart, Degrees Centigrade to Degrees Fahrenheit

FOR INTERPOLATION 1°C = 1.8°F									
°C	°F	°C	°F	°C	°F	°C	°F	°C	°F
-40	-40.0	80	176.0	195	383.0	310	590.0	480	896.0
-30	-22.0	85	185.0	200	392.0	315	599.0	490	914.0
-25	-13.0	90	194.0	205	401.0	320	608.0	500	932.0
-20	-4.0	95	203.0	210	410.0	325	617.0	510	950.0
-15	+5.0	100	212.0	215	419.0	330	626.0	520	968.0
-10	14.0	105	221.0	220	428.0	335	635.0	530	986.0
-5	23.0	110	230.0	225	437.0	340	644.0	540	1004.0
0	32.0	115	239.0	230	446.0	345	653.0	550	1022.0
5	41.0	120	248.0	235	455.0	350	662.0	560	1040.0
10	50.0	125	257.0	240	464.0	355	671.0	570	1058.0
15	59.0	130	266.0	245	473.0	360	680.0	580	1076.0
20	68.0	135	275.0	250	482.0	365	689.0	590	1094.0
25	77.0	140	284.0	255	491.0	370	698.0	600	1112.0
30	86.0	145	293.0	260	500.0	380	716.0	610	1130.0
35	95.0	150	302.0	265	509.0	390	734.0	620	1148.0
40	104.0	155	311.0	270	518.0	400	752.0	630	1166.0
45	113.0	160	320.0	275	527.0	410	770.0	640	1184.0
50	122.0	165	329.0	280	536.0	420	788.0	650	1202.0
55	131.0	170	338.0	285	545.0	430	806.0	660	1220.0
60	140.0	175	347.0	290	554.0	440	824.0	670	1238.0
65	149.0	180	356.0	295	563.0	450	842.0	680	1256.0
70	158.0	185	365.0	300	572.0	460	860.0	690	1274.0
75	167.0	190	374.0	305	581.0	470	878.0	700	1292.0

11. Engine Overspeed Condition

For engine subjected to overspeed conditions, refer to Figures 505 and 506.

12. Foreign Object Damage (FOD)

For engines subjected to foreign object damage (FOD) conditions, refer to Chapter 72-00-00, SPECIAL CONDITIONS INSPECTION, for action requirements.

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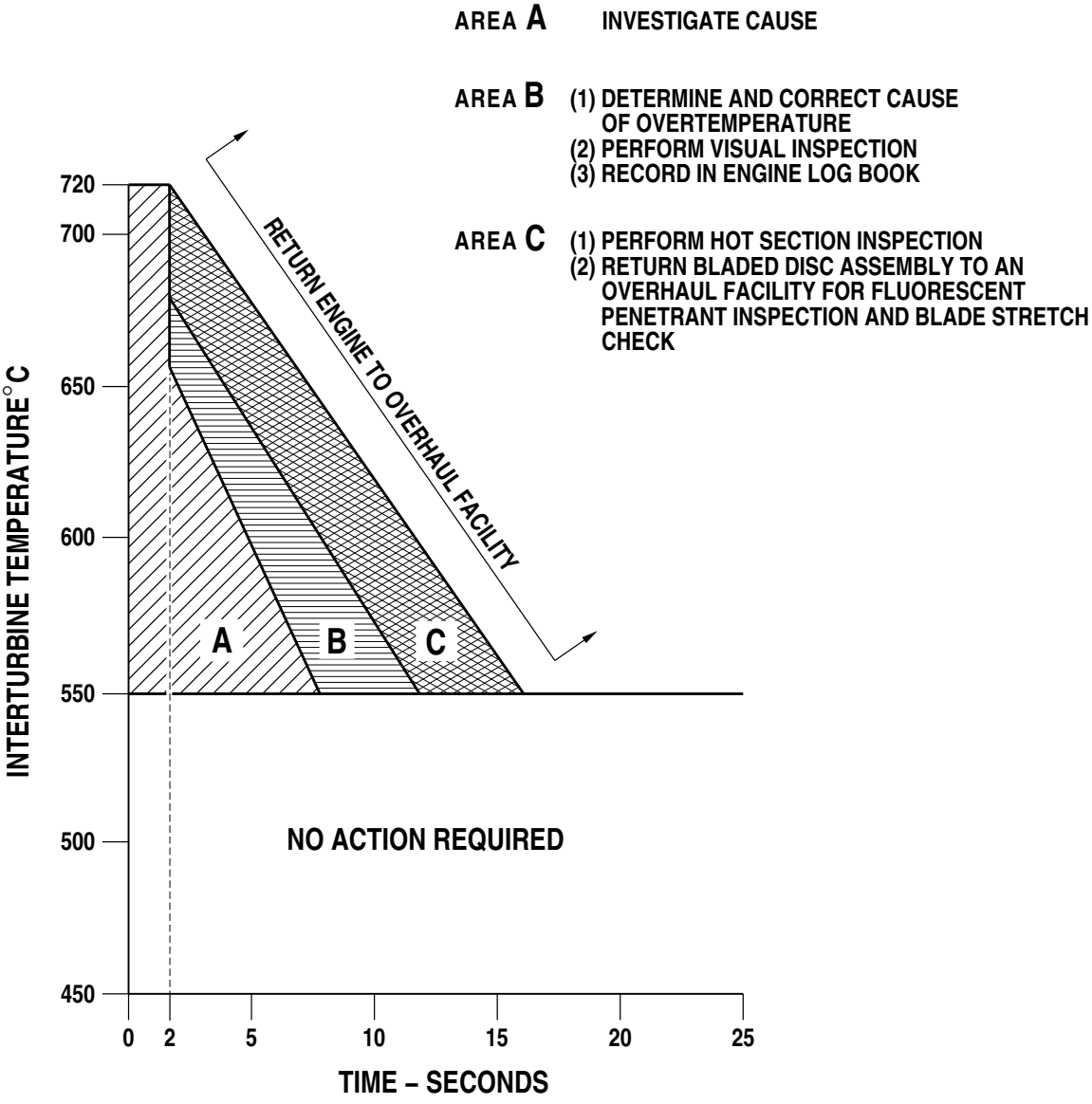
INTERTURBINE TEMPERATURES SHOWN MAKE NO ALLOWANCE FOR CORRECTION FACTORS OR INSTRUMENT ERRORS BUT DO ALLOW FOR SOME TYPICAL INSTRUMENT LAG.



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Overtemperature Limits - Starting Conditions Only
Figure 503

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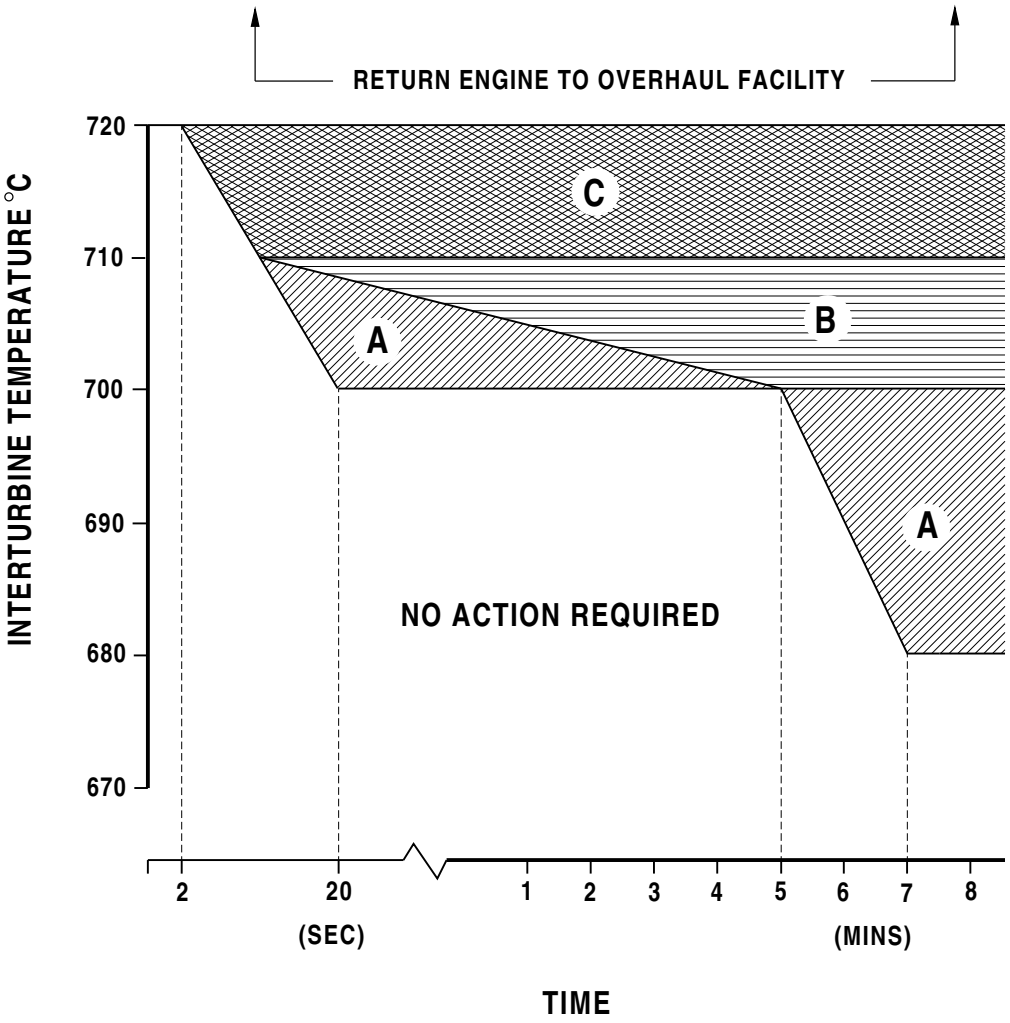
INTERTURBINE TEMPERATURE SHOWN MAKE NO ALLOWANCE FOR CORRECTION FACTORS OR INSTRUMENT ERRORS BUT DO ALLOW FOR SOME TYPICAL INSTRUMENT LAG

AREA A : (1) DETERMINE AND CORRECT CAUSE OF OVERTEMPERATURE
(2) PERFORM VISUAL INSPECTION
(3) RECORD IN ENGINE LOG BOOK

AREA B : PERFORM HOT SECTION INSPECTION

AREA C : (1) PERFORM HOT SECTION INSPECTION
(2) RETURN BLADED DISC ASSEMBLY FOR CRACK CHECK AND BLADE GROWTH CHECK



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Overtemperature Limits - All Conditions Except Starting
Figure 504

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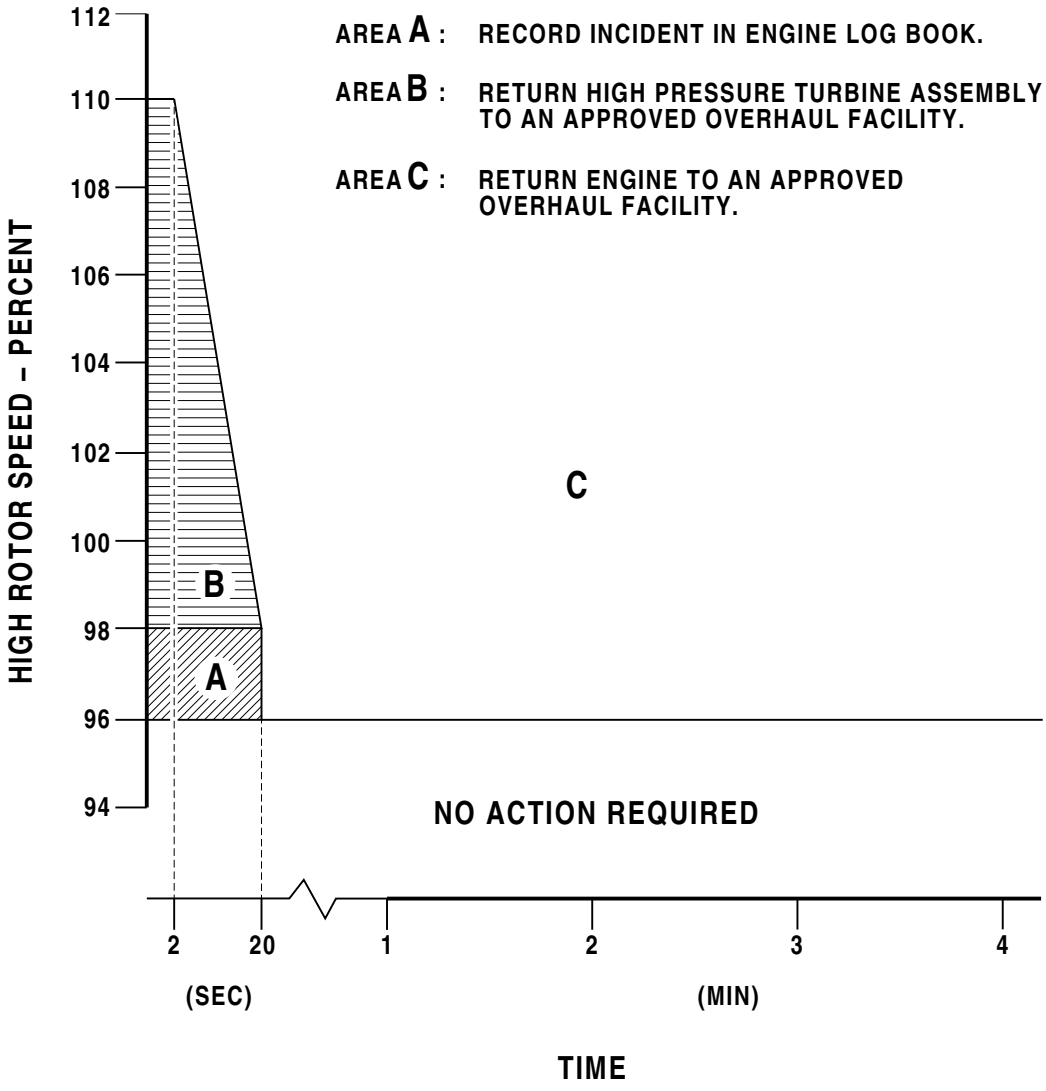

C11189C

High Rotor Overspeed Limits
Figure 505

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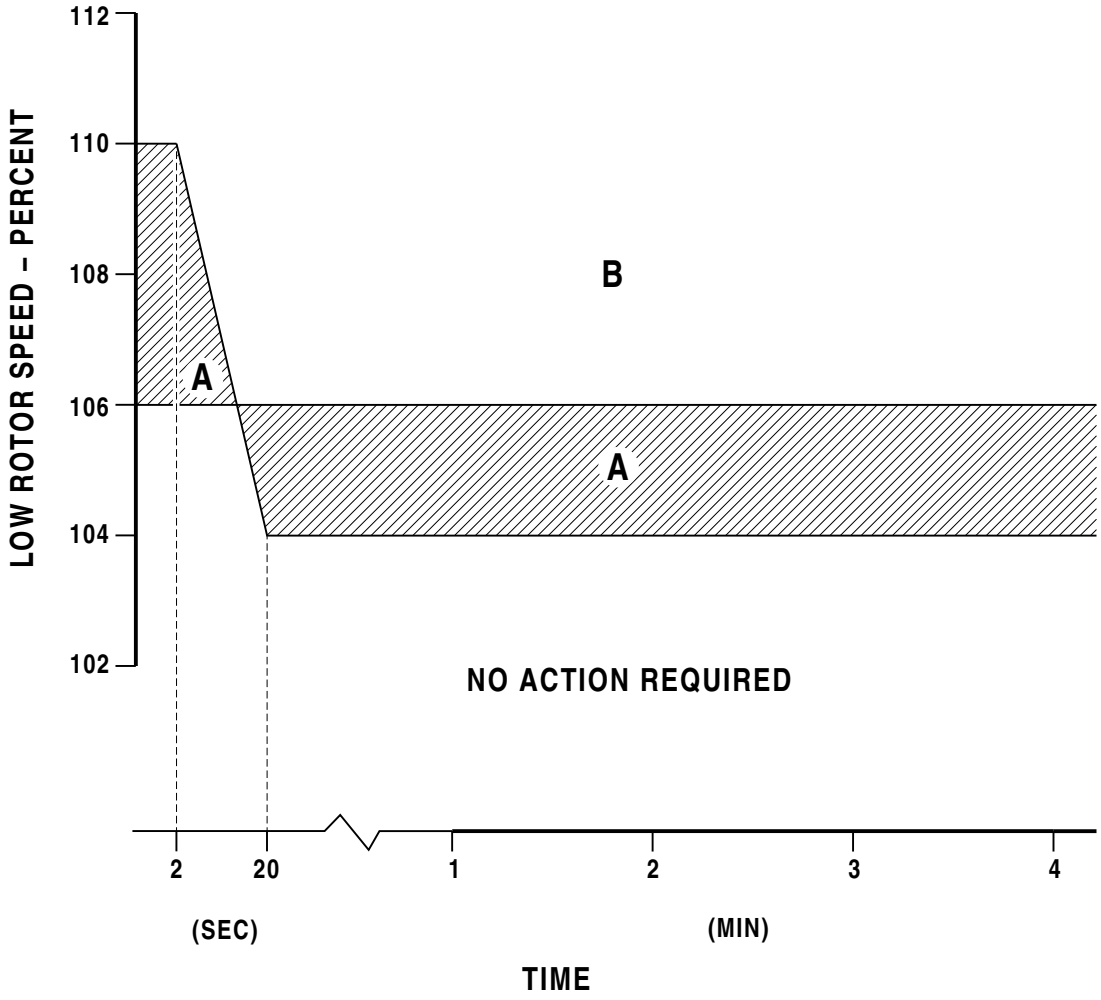
LOW ROTOR (N1) SPEEDS SHOWN MAKE NO ALLOWANCE FOR CORRECTION FACTORS OR INSTRUMENT ERRORS BUT DO ALLOW FOR SOME TYPICAL INSTRUMENT LAG

AREA A: **REPORT INCIDENT IN ENGINE LOG BOOK**

AREA B: **REMOVE LOW PRESSURE TURBINE ASSEMBLY AND RETURN TO AN APPROVED OVERHAUL FACILITY.**



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Low Rotor Overspeed Limits
Figure 506

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13. EEC Reversion

A. Engine Electronic Control (EEC) Reversion

(1) Following a reversion light indication, a drop in engine power will occur as the EEC is no longer functioning. In such an event, the following procedure should be adopted:

(a) Manually select EEC electrical power supply - OFF.

(b) Restore power required by advancing the power lever to the desired power setting.

NOTE: When attempting to restore normal EEC operation, the EEC electrical power supply should only be cycled OFF and ON with the PLA below the 80 degrees position. If normal operation is not achieved, then the EEC electrical power supply should be selected OFF and the flight completed in the manual mode, modulating the power lever as required.

14. Fuel

It is recommended that all testing be carried out using the same fuel as that used in service.

15. Precipitation

Performance and trim checks should not be attempted during moderate to heavy precipitation or fog. Water entering the engine inlet changes the power output of the engine, the change being proportional to the amount of water ingested. Any form of moisture in the air causes the engine to ingest water. This includes occasions when water or snow is blown into the air inlet, or sucked in by the LP compressor. Freezing rain or slush snow has exactly the same effect on power output as water ingestion and, in addition, may cling to inlet ducts and upset the flow of air to the engine.

16. Fuel Manifold Pressure Checks - Recommendations

NOTE: For more information about the engine fuel nozzles and the fuel manifold, refer to Chapter 73-10-05, DESCRIPTION AND OPERATION and MAINTENANCE PRACTICES.

A. General

(1) The primary and secondary fuel manifold pressure checks (Ref. Para. 18.) are diagnostic tools used to identify restrictions to primary and secondary fuel flow through the fuel nozzles. The checks takes approximately one hour to perform using the approved equipment.

(2) Nozzle restrictions can affect the quality of nozzle spray which may cause a reduction in combustion efficiency and premature hot end damage, with a resultant high cost Hot Section Inspection. In an extreme case, the ability to make power (N1) or acceleration time to ground idle speed could be affected.

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(3) The cause of nozzle blockage is usually carbon buildup, although fuel contamination has contributed in some cases.

(4) Carbon buildup is aggravated by:

(a) Excessive operation below 46 % N2.

(b) Rapid shutdowns after landing (soak-back effect).

(c) Nozzles refurbished by shops not authorized by P&WC (secondary passages not cleaned).

(5) If operating environment is in above conditions, it may be beneficial to perform a fuel manifold pressure check.

B. Secondary Fuel Manifold Pressure Check

(1) For JT15D-5 (Pre-SB7493 and Pre-SB7526) engines, frequency of the secondary fuel manifold check is at the operator's discretion. Operators may carry out this check at:

(a) Mid-HSI life: approximately 850 hours.

(b) As a trending method, every 200 to 300 hours.

(c) At an aircraft scheduled maintenance interval. The check may be performed using basic pressure gage equipment and hoses.

(2) Refer to Subpara. 19.K. for procedure.

C. Primary Fuel Manifold Pressure Check

(1) The primary manifold pressure check is provided for fault isolation for JT15D-5 (Post-SB7493, Post-SB7526 and Post-SB7598) and JT15D-5R fuel nozzle adapter assemblies and is not required for component replacement, or at engine installation.

(2) Refer to Subpara. 19.16. for procedure.

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17. Extreme Weather Conditions

A. Cold Weather Procedures

WARNING: AFTER SEVERAL MINUTES OF HEAT APPLICATION, FUEL DRAINING FROM A COMPONENT AFFECTED BY ICE DOES NOT NECESSARILY INDICATE THAT ALL ICE HAS MELTED. PARTICLES OF ICE MAY STILL REMAIN IN THE UNIT CAUSING A SERIOUS POTENTIAL FLIGHT HAZARD. CONTINUE TO APPLY HEAT FOR A PERIOD OF TIME AND FREQUENTLY INSPECT DRAINAGE UNTIL EVIDENT THAT ALL WATER HAS BEEN REMOVED.

CAUTION: CAREFULLY MONITOR FUEL AND OIL PRESSURES DURING STARTING OF AN ENGINE WHICH HAS BEEN EXPOSED TO OVERNIGHT LOW AMBIENT TEMPERATURE. SHUT DOWN ENGINE IMMEDIATELY IF, IN EITHER SYSTEM, THERE IS NO INDICATION OR AN INDICATION WHICH IS BELOW NORMAL OPERATING LIMITS. INSPECT FOR ICE IN BOTH SYSTEMS. IF PRESENT, APPLY HOT AIR BEFORE ATTEMPTING ANOTHER START.

The solubility of water in fuel diminishes as temperatures drop, resulting in water/fuel separation, with water tending to accumulate at the lowest level of tank, system or affected component. Further temperature reduction or continued cold soaking of the engine causes formation of ice particles which may partially block the fuel system strainers, thus reducing fuel flow. In extreme conditions total blockage of the strainer(s) may occur, indicated by a marked reduction or complete loss of fuel flow to the engine. The application of heat to the engine and fuel system components will prevent or remedy such instances.

Preheating engines exposed to cold soaking in temperatures below -29°C (-19°F) is recommended with particular attention to accessory gearbox and fuel system components.

In these conditions, it is of the utmost importance that all fuel system, sumps and strainers be thoroughly inspected on all preflight checks. Any indication of restricted free fuel flow from the system drains is indicative of ice formation and warm air must be liberally applied. Open the drain frequently and check for continued free, uncontaminated fuel flow during warm air application. Collect all drainage in a clean container and inspect for water globules in the fuel.

Similar conditions of ice formation can exist in the engine lubrication system due to condensation in the tank or engine case area. Shutting down a hot engine in low ambient temperature conditions, followed by a cold soak period in the open, will certainly increase the probability of ice formation in both fuel and lubrication systems.

B. Hot Weather Procedures

No special precautions or procedures are required for engine starting during hot weather.

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18. Ground Testing

A. Ground testing is intended to give an engine a thorough test for mechanical soundness and for indications of correct operating parameters. Aircraft installations differ and reference should be made to the power plant section of the applicable Airframe Maintenance Manual. Ground testing normally comprises ten checks and, if necessary, a motoring run. For JT15D-5 (Post-SB7493, Post-SB7526 and Post-SB7598) and JT15D-5R engines, an additional primary fuel manifold pressure check (Ref. Subpara. 19.16.) may be required during engine fault isolation procedures.The normal checks are as follows:

B. The normal checks are as follows:

Check No. 1 - Prestart (Refer to Para. 19.A.)
Motoring Run (Refer to Para. 19.B.)
Check No. 2 - Engine Start (Refer to Para. 19.E.)
Check No. 3 - Engine Shutdown (Refer to Para. 19.F.)
Check No. 4 - Engine Calibration (Refer to Para. 19.G.)
Check No. 5 - Engine Performance (Refer to Para. 19.H.)
Check No. 6 - EEC Authority (Refer to Para. 19.I.)
Check No. 7 - Minimum Fuel Flow - (Refer to Para. 19.K.)
Check No. 8 - Secondary Fuel Manifold Pressure Check (Refer to Para. 19.K.)

C. Refer to Table 503 for list of ground checks to complete following replacement or repair of specific components, engine installation or after HSI.

TABLE 503, Ground Checks Required After Major Component Repair/Replacement or Engine Installation

OPERATION	CHECKS/PROCEDURES REQUIRED	CHAPTER REFERENCE
Bleed Valve Actuator	1, 2, 5, 3	73-10-02
Combustion Chamber Liner	1, 2, 4, 3	72-40-01
EEC Replacement	1, 2, 6, 3	73-20-03
Engine Installation	1, 2, 4, 8, (See NOTE 1.) 3, 10	72-00-00
Fan Case Replacement or Repair	1, 2, 4, 3	72-30-01
Fan Replacement or Repair	1, 2, 4, 3	72-30-03
Flow Divider Valve Replacement	1, 2, 5 3	73-10-04
Fuel Filter (JT15D-5R)	1, 2, 3	73-10-13
Fuel Manifold	1, 2, 4, 3	73-10-05
Fuel Nozzle Replacement	1, 2, 8 (See NOTE 1.), 4, 3	73-10-05
Fuel/Oil Heat Exchanger Replacement (JT15D-5R)	1, 2, 3	73-10-14

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TABLE 503, Ground Checks Required After Major Component Repair/Replacement or Engine Installation (Cont'd)

OPERATION	CHECKS/PROCEDURES REQUIRED	CHAPTER REFERENCE
Fuel Pressure Tubes	1, 2, 5, 3	73-10-08
Fuel Pump Replacement	1, 2, 5, 9, 6, 7, 3, 10	73-10-02
HMU Replacement	1, 2, 9, 6, 7, 4, 3	73-20-02
HSI	1, 2, 8, (See NOTE 1.) 4, 3, 10	72-00-00
Ignition System Components Replacement	1, 2, 3	74-10-01 74-20-01 74-20-02
Oil Cooler Replacement	1, 2, 5, 3	73-10-01
Starter-Generator Replacement	1, 2, 3	72-60-01
NOTE 1.: The secondary manifold pressure check is required for JT15D-5 engines with Pre-SB7493, duplex-style fuel nozzle adapter assemblies.		
NOTE 2.: The ground checks are listed in required sequence.		

19. Engine Ground Checks

A. Check No. 1 - Premotoring or Prestart

(1) Thoroughly inspect engine inlet system and ensure that it is clear of loose nuts, bolts, tools and other objects which may cause engine damage and possible subsequent failure.

(2) Inspect runup area in vicinity of engine inlet system and exhaust (Ref. Fig. 501) and remove any loose objects which might possibly be ingested by the engine or be blown rearward by the velocity of the exhaust gases.

(3) Check for signs of contamination of inlet and exhaust duct by fuel or oil.

(4) Check fuel system for presence of water.

(5) Check engine controls for full travel and freedom of movement.

(6) Check engine oil level (Ref. 72-00-00, SERVICING - Servicing the Engine Oil System).

B. Dry Motoring Run

(1) This procedure is used to clean an engine whenever it is deemed necessary to remove internally trapped fuel and vapor. Air passing through the engine serves to purge fuel vapor from the combustion section, turbines and engine exhaust tailpipe. Accomplish as follows:

(a) Accomplish a premotoring or prestart check No. 1 (Ref. Para. 19.A.).

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(b) Power Lever - CUT-OFF.

(c) Ignition Switch - OFF.

(d) Electrical Power Supply Switch - ON.

(e) Fuel System Shutoff Switch - ON.

(f) Fuel Boost Pump Switch - ON. (To provide lubrication for engine driven fuel pumping elements.)

(g) Engine Starter Switch - ON.

(h) Maintain starter operation for the desired duration. Observe the starter limits (refer to applicable starter manufacturer's manual).

(i) Engine Starter Switch - OFF.

(j) Fuel Boost Pump Switch - OFF.

(k) Fuel System Shutoff Switch - FUEL OFF.

(l) Electrical Power Supply Switch - OFF.

(m) Allow starter to cool for specified period before attempting another start operation.

C. Wet Motoring Run

CAUTION: THIS PROCEDURE IS USED STRICTLY FOR MAINTENANCE PURPOSES AND IS NOT PART OF NORMAL START PROCEDURE. AFTER A WET MOTORING RUN, A DRY MOTORING RUN (REF. SUBPARA. B. PRECEDING) MUST BE ACCOMPLISHED BEFORE ANY START IS ATTEMPTED.

(1) Accomplish wet motoring run as follows:

(a) Accomplish premotoring or prestart check No. 1 (Ref. Subpara. 19.A.).

(b) Power Lever - CUT-OFF.

(c) Ignition Switch - OFF.

(d) Engine Electronic Control (EEC) - OFF.

(e) Electrical Power Supply Switch - ON.

(f) Fuel System Shutoff Switch - ON.

(g) Fuel Boost Pump Switch - ON.

(h) Engine Starter Switch - ON.

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(i) Power Lever - IDLE: Maintain starter operation for desired duration within limits.

NOTE: Observe starter limits (refer to applicable starter manufacturer's manual).

(j) Power Lever - CUT-OFF.

(k) Engine Starter Switch - OFF.

(l) Fuel Boost Pump Switch - OFF.

(m) Fuel System Shutoff Switch - FUEL OFF.

(n) Electrical Power Supply Switch - OFF.

(o) Check oil lines, fuel lines and connections for leaks. None are allowed except at normal seepage drains.

(p) Allow starter to cool for specified period, then accomplish a dry motoring run (Ref. Subpara. B., preceding).

D. Emergency - Ground Engine Fire

(1) In the event of a ground engine fire, during or after an attempted start, the following procedure should be used:

(a) Power Lever - CUT-OFF.

(b) Electrical Power Supply Switch - ON.

(c) Fuel Boost Pump Switch - OFF.

(d) Fuel System Shutoff Switch - OFF.

(e) Engine Starter Switch - ON.

(f) Maintain starter operation for the desired duration. Observe starter limits (refer to the applicable starter manufacturer's manual).

(g) Engine Starter Switch - OFF.

(h) Electrical Power Supply Switch - OFF.

(i) Allow cooling for the starter before any further starting operation is attempted.

E. Check No. 2 - Engine Start

(1) Accomplish Premotoring or Prestart Check (Ref. Para. 19.A.) then proceed as follows:

(a) Power Lever - CUT-OFF.

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(b) Electrical Power Supply Switch - ON.

(c) Fuel System Shutoff Switch - FUEL ON.

(d) Fuel Boost Pump Switch - ON.

(e) Fuel Inlet Pressure Indicator - Check 5 psig minimum (if aircraft is equipped with gage or light to ensure that fuel is being delivered to engine fuel inlet).

(f) Fuel Inlet Pressure Indicator - Check minimum (if aircraft is equipped with gage or light to ensure that fuel is being delivered to engine fuel inlet).

(g) Hydraulic System Switch - OFF.

(h) Bleed Air - OFF.

(i) Engine Electronic Control (EEC) Switch - ON.

(j) Engine Starter Switch - ON. Check for oil pressure rise.

CAUTION: DO NOT SWITCH IGNITION ON UNTIL THE N2 COMPRESSOR IS ROTATING.

(k) Ignition Switch - ON.

CAUTION: WHENEVER THE ENGINE FAILS TO LIGHT UP WITHIN 10 SECONDS AFTER MOVING POWER LEVER TO IDLE POSITION, CUT OFF FUEL AND IGNITION AND CONTINUE MOTORING THE COMPRESSOR WITH STARTER FOR AN ADDITIONAL 15 SECONDS TO CLEAR TRAPPED FUEL AND VAPORS. THE COMPRESSOR SHOULD BE ALLOWED TO DECELERATE TO ZERO RPM BEFORE ATTEMPTING ANOTHER START.

(l) Power Lever - IDLE, when N2 accelerates through 8%.

(m) Ensure that engine accelerates normally to idle rpm and that the maximum allowable turbine temperature starting limit is not exceeded.

(n) When engine has reached idle:

1 Engine Starter Switch - OFF.

2 Ignition Switch - OFF.

(2) Satisfactory Start

(a) Starting will be considered satisfactory when the following conditions are met:

1 Lightup takes place within 10 seconds of advancing power lever to IDLE.

2 Engine accelerates normally to idle rpm.

3 Turbine temperature does not exceed the nominal start temperature during transition period to idle rpm (Ref. Fig. 503).

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4 Oil pressure is at least 40 psig.

(3) Unsatisfactory Start

(a) No Start - If this condition exists, as indicated by failure to light up within 10 seconds of advancing power lever to idle position or no indication of turbine temperature and/or no increase in rpm, proceed as follows:

1 Move power lever to CUT-OFF and ignition switch to OFF.

2 EEC Switch - OFF

3 Continue to motor engine, using starter to clear trapped fuel and vapor (Ref. Para. 19.B.(1)).

4 Allow compressors to come to rest before attempting another start.

CAUTION: IN THE EVENT OF A HUNG START, DO NOT ADVANCE POWER LEVER BEYOND IDLE.

(b) False or Hung Start - Indicated by a normal engine lightup, but N2 rpm remains below normal idle rpm. If this condition exists, proceed as detailed in step (a), preceding.

CAUTION: IF TURBINE TEMPERATURE CONTINUES TO RISE, OR IF THE RATE OF RISE IS ABNORMALLY FAST, SHUT DOWN ENGINE BEFORE TEMPERATURE LIMITS ARE EXCEEDED.

(c) Hot Start - Indicated by turbine temperature which continues to rise and exceeds or will exceed operating limits (Ref. Figs. 503 and 504). If this condition exists, shut down engine before temperature limits are exceeded.

NOTE: A hot start may be anticipated, if, when advancing power lever to IDLE, fuel flow exceeds normal.

(d) Low Oil Pressure - Shut down engine immediately if indicated oil pressure is below 40 psig.

F. Check No. 3 - Engine Shutdown

(1) Accomplish engine shutdown as follows:

(a) Power Lever - IDLE.

(b) Allow engine turbine temperature to drop and stabilize. Allow to remain stabilized for a minimum of one minute.

(c) Power Lever - CUT-OFF.

(d) Engine Electronic Control (EEC) Switch - OFF.

(e) Fuel Boost Pump Switch - OFF.

(f) Fuel System Shutoff Switch - FUEL OFF.

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(g) Electrical Power Supply Switch - OFF.

WARNING: IF THERE IS ANY EVIDENCE OF FIRE WITHIN THE ENGINE AFTER SHUTDOWN, PROCEED WITH ACTION DETAILED IN SUBPARA. 19.D.).

(h) If engine does not decelerate freely during shutdown and/or unusual noise is heard, refer to Chapter 72-00-00, FAULT ISOLATION.

G. Check No.4 - Engine Calibration

(1) An initial ground calibration run to establish installed N1 rotor speed, N2 rotor speed and T5 temperature relationship must be completed after installation of new or overhauled engine.

(2) Engine performance is greatly affected by local atmospheric conditions.

CAUTION: DO NOT PERFORM ENGINE CALIBRATION RUN IN HIGH WIND OR MODERATE TO HEAVY RAIN, SNOW OR FOG CONDITIONS.

(3) Ground run engine to obtain calibration curves as follows:

(a) Ensure instrumentation is functioning correctly and has been accurately calibrated.

(b) Ensure class of cold nozzle fitted corresponds to class specified on engine data plate located on underside of accessory gearbox (Ref. Para. 9.).

(c) Ensure all engine bleed air ports for aircraft services are blanked off with gaskets and covers.

(d) Position aircraft into wind and away from the influence of buildings or other obstacles.

(e) Accomplish a prestart check (Check No. 1) (Ref. Para. 19.A.).

(f) Obtain and record local ambient temperature. Where it can be obtained, compare tower OAT value to aircraft indication.

(g) Refer to Airframe Maintenance Manual to obtain the rated TAKEOFF % N1 value and the corresponding N2 and T5 maximum limits for recorded local ambient temperature and pressure altitude. Record takeoff rating data per Figure 507.

(h) Accomplish engine start (Ref. Para. 19.E.).

(i) Ensure all bleed air and accessory loads are OFF. Check aircraft systems to ensure there are no bleed leaks.

(j) Advance power lever to the TAKEOFF detent with EEC selected ON and allow engine to stabilize for three minutes.

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CAUTION: DO NOT EXCEED MAXIMUM LIMITS OF N2 AND T5 PREVIOUSLY OBTAINED. IF EITHER MAXIMUM VALUE IS EXCEEDED, REFER TO CHAPTER 72-00-00, FAULT ISOLATION, FOR CORRECTIVE ACTION. FOLLOWING RECTIFICATION REPEAT CALIBRATION CHECK.

(k) Record N1 rotor speed, N2 rotor speed and T5 temperature observed at the following five power lever settings per Figure 507:

1 Rated TAKEOFF N1%

2 Rated TAKEOFF N1 - 2%

3 Rated TAKEOFF N1 - 4%

4 Rated TAKEOFF N1 - 6%

5 Rated TAKEOFF N1 - 10%

NOTE: 1. Allow a minimum of 3 minutes for engine to stabilize at each N1 condition.

NOTE: 2. When setting to engine conditions as required, move the power lever in one direction only and when set, do not make further adjustments.

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TABLE 504, Ambient Temperature Correction Factors for Specified Temperatures

T (amb) °C	θ	√θ	D	T (amb) °C	θ	√θ	D
-30	0.8438	0.9186	50.55	10	0.9826	0.9913	4.82
-29	0.8473	0.9205	49.23	11	0.9861	0.9930	3.85
-28	0.8508	0.9224	47.91	12	0.9896	0.9948	2.87
-27	0.8542	0.9243	46.61	13	0.9931	0.9965	1.91
-26	0.8577	0.9261	45.31	14	0.9965	0.9983	0.95
-25	0.8612	0.9280	44.03	15	1.0000	1.0000	0.00
-24	0.8647	0.9299	42.76	16	1.0035	1.0017	-0.94
-23	0.8681	0.9317	41.49	17	1.0069	1.0035	-1.88
-22	0.8716	0.9336	40.24	18	1.0104	1.0052	-2.81
-21	0.8751	0.9354	39.00	19	1.0139	1.0069	-3.74
-20	0.8785	0.9373	37.77	20	1.0174	1.0086	-4.66
-19	0.8820	0.9392	36.54	21	1.0208	1.0104	-5.57
-18	0.8855	0.9410	35.33	22	1.0243	1.0121	-6.48
-17	0.8889	0.9428	34.12	23	1.0278	1.0138	-7.38
-16	0.8924	0.9447	32.93	24	1.0312	1.0155	-8.27
-15	0.8959	0.9465	31.74	25	1.0347	1.0172	-9.16
-14	0.8994	0.9483	30.57	26	1.0382	1.0189	-10.04
-13	0.9028	0.9502	29.40	27	1.0416	1.0206	-10.92
-12	0.9063	0.9520	28.24	28	1.0451	1.0223	-11.79
-11	0.9098	0.9538	27.09	29	1.0486	1.0240	-12.66
-10	0.9132	0.9556	25.95	30	1.0521	1.0257	-13.52
-9	0.9167	0.9574	24.82	31	1.0555	1.0274	-14.37
-8	0.9202	0.9593	23.69	32	1.0590	1.0291	-15.22
-7	0.9237	0.9611	22.58	33	1.0625	1.0308	-16.06
-6	0.9271	0.9629	21.47	34	1.0659	1.0324	-16.90
-5	0.9306	0.9647	20.37	35	1.0694	1.0341	-17.73
-4	0.9341	0.9665	19.28	36	1.0729	1.0358	-18.55
-3	0.9375	0.9683	18.20	37	1.0763	1.0375	-19.38
-2	0.9410	0.9701	17.13	38	1.0798	1.0391	-20.19
-1	0.9445	0.9718	16.06	39	1.0833	1.0408	-21.00
0	0.9479	0.9736	15.00	40	1.0868	1.0425	-21.81
1	0.9514	0.9754	13.95	41	1.0902	1.0441	-22.61
2	0.9549	0.9772	12.91	42	1.0937	1.0458	-23.40
3	0.9584	0.9790	11.87	43	1.0972	1.0475	-24.19
4	0.9618	0.9807	10.84	44	1.1006	1.0491	-24.98
5	0.9653	0.9825	9.82	45	1.1041	1.0508	-25.76
6	0.9688	0.9843	8.81	46	1.1076	1.0524	-26.53
7	0.9722	0.9860	7.80	47	1.1111	1.0541	-27.30
8	0.9757	0.9878	6.80	48	1.1145	1.0557	-28.07
9	0.9792	0.9895	5.81	49	1.1180	1.0574	-28.83

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TABLE 504, Ambient Temperature Correction Factors for Specified Temperatures (Cont'd)

T (amb) °C	θ	√θ	D	T (amb) °C	θ	√θ	D
50	1.1215	1.0590	-29.58				

(l) Convert Observed Data to Corrected Data as follows:

1

$$N1\ corrected = \frac{N1\ observed}{\sqrt{\theta}}$$

2

$$N2\ corrected = \frac{N2\ observed}{\sqrt{\theta}}$$

3

$$T5\ (degrees\ C)\ corrected = \frac{T5\ observed}{\theta} + D$$

NOTE: D is a function of θ and absolute temperature factor of 273.15°C. It is a factor created for convenient computation.

4 Example:

Ambient Temperature =	28°C
N1 obs =	91.2%
N2 obs =	92.8%
T5 obs =	660°C
θ =	1.0451
D =	- 11.79
√θ=	1.0223

5

$$N1\ corr = \frac{91.2\%}{1.0223} = 89.2\%$$

6

$$N2\ corr = \frac{92.8\%}{1.0223} = 90.8\%$$

7

$$T5\ (°C)\ corr = \frac{660°C}{1.0451} - 11.79 = 620°C$$

(m) Shut down engine on completion of calibration check run (Ref. Para. 19.F.).

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(n) Convert observed N1, N2 and T5 data recorded during calibration run to corrected standard day values per Table 504 ambient temperature value. Record corrected values per Figure 507.

(o) Plot N2 and T5 against N1 as shown on Figure 507 using corrected data obtained at step (n). If it is not possible to plot five N1 conditions, use four N1 conditions.

(p) If a plotted T5 value is off the calibration curve by ± 10°C or more, repeat ground calibration run for the corresponding N1 condition record data. If T5 value for repeated N1 condition is still off calibration curve by ± 10°C or more, check integrity of instrumentation.

NOTE: Power lever must be moved in same direction as first calibration run.

H. Check No. 5 - Engine Performance

(1) Engine performance is greatly affected by local atmospheric conditions.

CAUTION: DO NOT PERFORM ENGINE PERFORMANCE CHECK IN HIGH WIND OR MODERATE TO HEAVY RAIN, SNOW OR FOG CONDITIONS.

(2) Check engine performance as follows:

(a) Ensure instrumentation is functioning correctly and has been accurately calibrated.

(b) Ensure class of cold nozzle fitted corresponds to the class specified on engine data plate located on underside of accessory gearbox (Ref. Para. 9.).

(c) Ensure all engine bleed air ports for aircraft services are blanked off with gaskets and covers.

(d) Position aircraft into wind and away from influence of buildings of other obstacles.

(e) Accomplish a prestart check (Check No. 1) (Ref. Para. 19.A.).

(f) Obtain and record local ambient temperature. Where it can be obtained, compare tower OAT value to aircraft indication.

(g) Refer to Airframe Maintenance Manual to obtain the rated TAKEOFF N1 value and the corresponding N2 and T5 maximum limits for recorded local ambient temperature and pressure altitude. Record takeoff rating data per Figure 507.

(h) Accomplish engine start (Ref. Para. 19.E.).

(i) Ensure that all air bleeds and accessory loads are OFF.

1 Physically check aircraft systems to ensure there are no bleed leaks.

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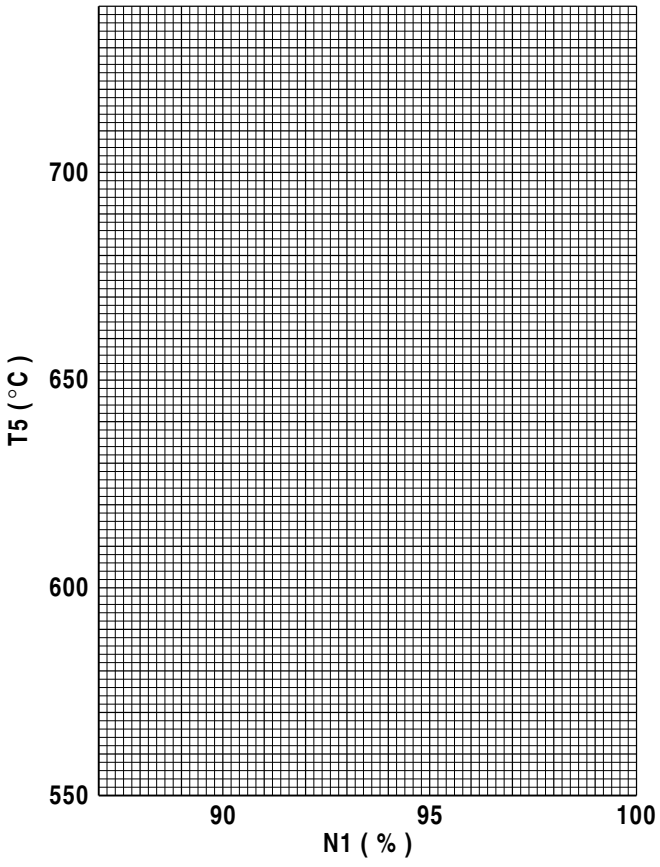
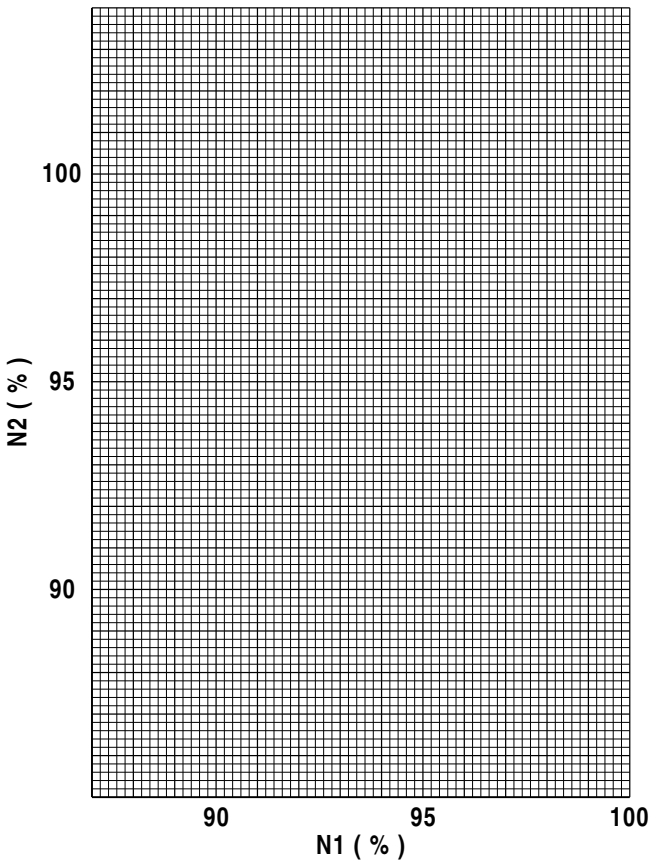
TABLE 503

DATE: _____
ENGINE S/N: _____
PRESSURE ALTITUDE (FT): _____
AMBIENT TEMPERATURE (°C): _____

RATED T/O N1 (%): _____
MAX N2 (%): _____
MAX T5 (°C): _____

CONDITION		OBSERVED DATA			CORRECTED DATA			COMMENTS
		N1 %	N2 %	T5 (°C)	N1 %	N2 %	T5 (°C)	
T/O	N1							
	–2%							
	–4%							
	–6%							
	–10%							





C32968

Engine Calibration and Performance Check Curve
Figure 507

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2 For the purpose of performance check, it is recommended that aircraft bleed lines be disconnected at engine bleed pad(s) and pad(s) blanked off with gasket(s) and cover(s).

CAUTION: DO NOT EXCEED MAXIMUM VALUES OF N2 AND T5 PREVIOUSLY DETERMINED. IF EITHER MAXIMUM VALUE IS EXCEEDED, REFER TO CHAPTER 72-00-00, FAULT ISOLATION, FOR CORRECTIVE ACTION. FOLLOWING RECTIFICATION, REPEAT THE PERFORMANCE CHECK.

(j) Advance power lever to the TAKEOFF detent and allow engine to stabilize for three minutes. Record observed values of N1, N2 and T5 per Figure 507.

(k) Shut down engine on completion of performance check run (Ref. Para. 19.F.).

I. Check No.6 - EEC Authority (Ref. Fig. 508

CAUTION: EEC AUTHORITY MUST NOT BE USED AS A METHOD OF MATCHING LEFT AND RIGHT ENGINE PARAMETERS. SUCH ACTIONS WILL CAUSE IN-SERVICE CONTROL SYSTEM DIFFICULTIES.

(1) Position the aircraft into the wind.

(2) Do the premotoring or prestart check (Check No. 1) (Ref. Para. 19.A.).

(3) Do the engine start (Check No. 2) (Ref. Para.19.E.).

(4) Refer to Airframe Maintenance Manual to obtain the rated take-off %N1 value and the corresponding N2 and T5 maximum limits for the particular ambient temperature and pressure altitude.

(5) Advance power lever to take-off N1 with EEC ON and stabilize engine for three minutes.

(6) Proceed as follows:

(a) If take-off N1 power is met, do the Step (7).

(b) If take-off N1 power cannot be met with the EEC on, shutdown the engine and refer to 72-00-00, Fault Isolation chart for engine does not meet take-off power for the day.

CAUTION: THE MAXIMUM VALUES OF N2 AND T5 MUST NOT BE MORE THAN THE VALUES PREVIOUSLY DETERMINED. IF EITHER MAXIMUM VALUE IS MORE THAN THE DETERMINED VALUE, REFER TO CHAPTER 72-00-00, FAULT ISOLATION, FOR CORRECTIVE ACTION. FOLLOWING RECTIFICATION, REPEAT EEC AUTHORITY CHECK.

(7) Record N1%, ambient temperature and pressure altitude.

(8) Switch EEC OFF and stabilize engine for one minute.

(9) Record N1.

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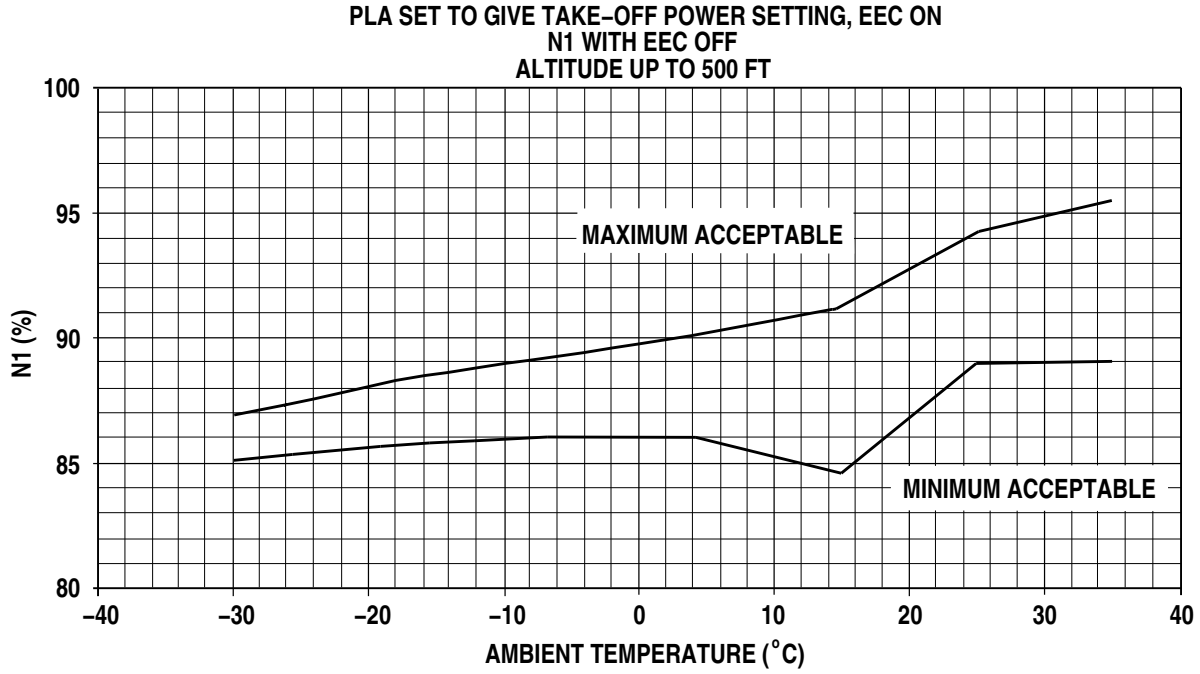

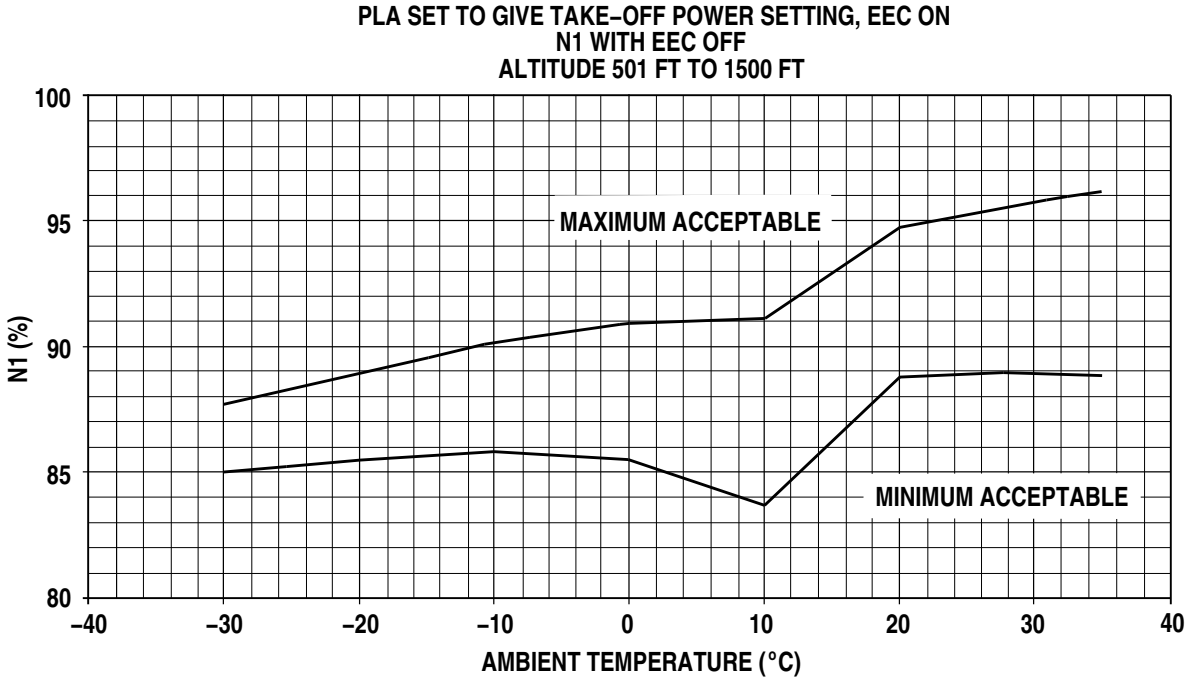

C222386

EEC Authority Limits
Figure 508 (Sheet 1 of 4)

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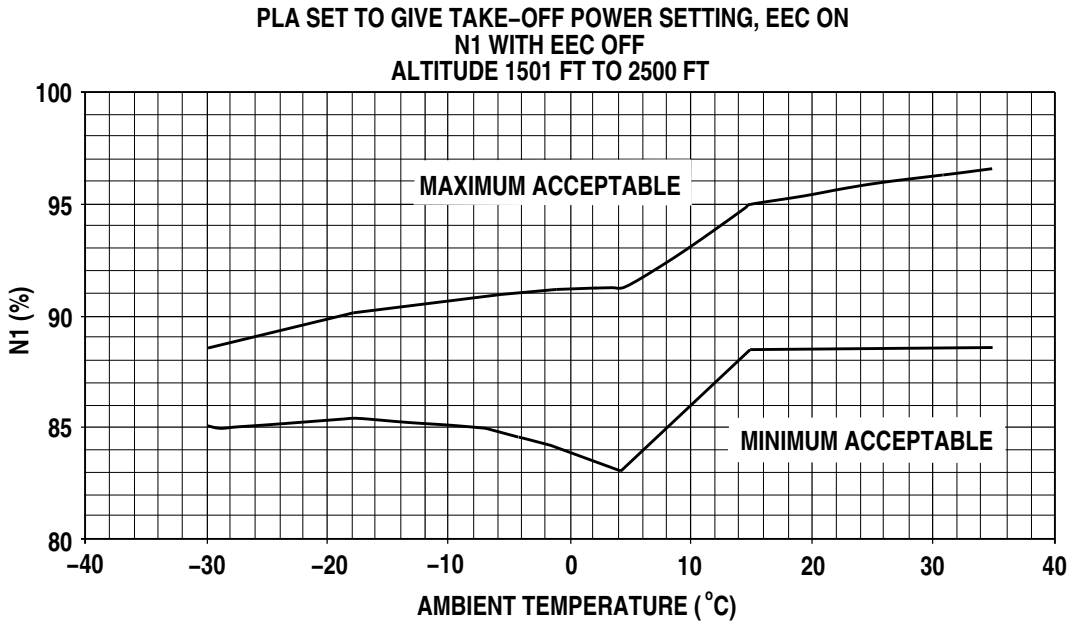

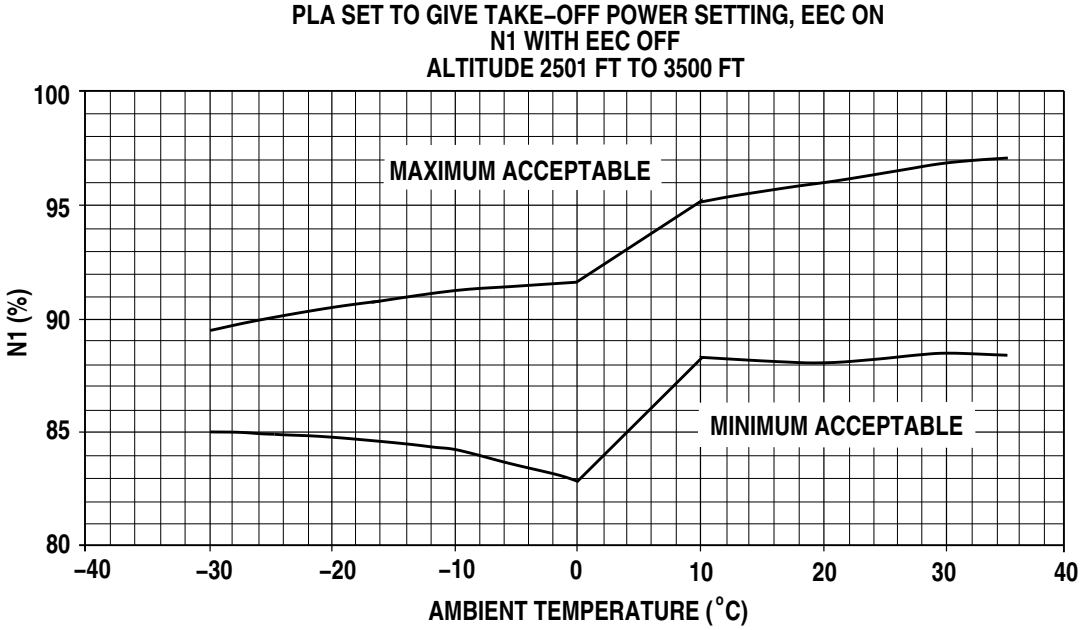

C222387

EEC Authority Limits
Figure 508 (Sheet 2)

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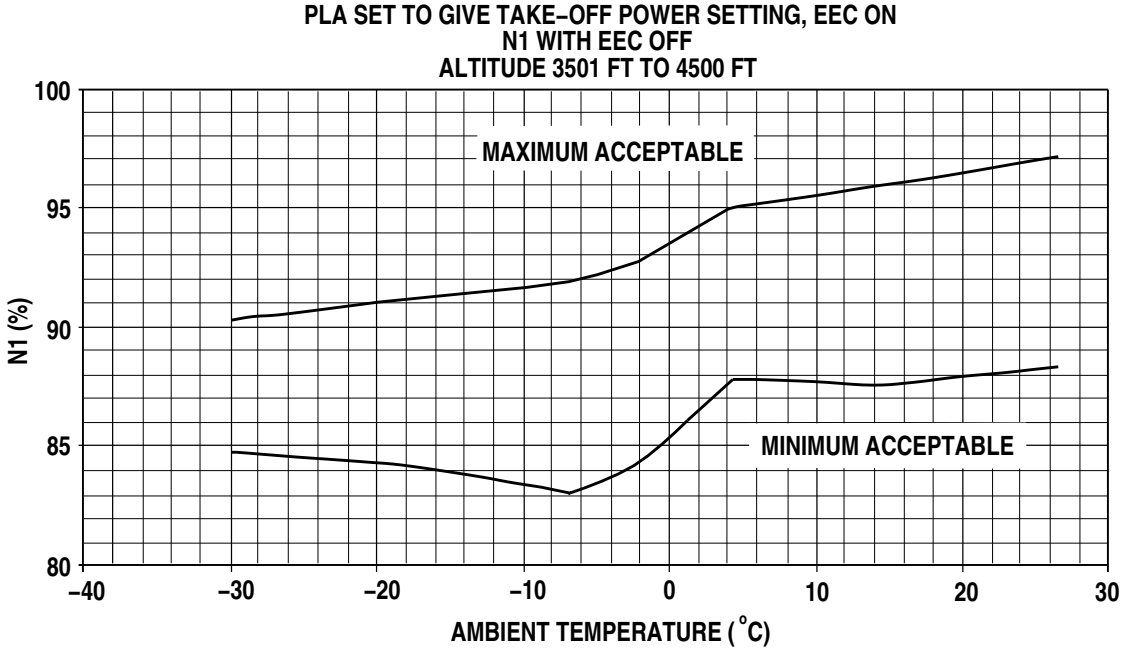

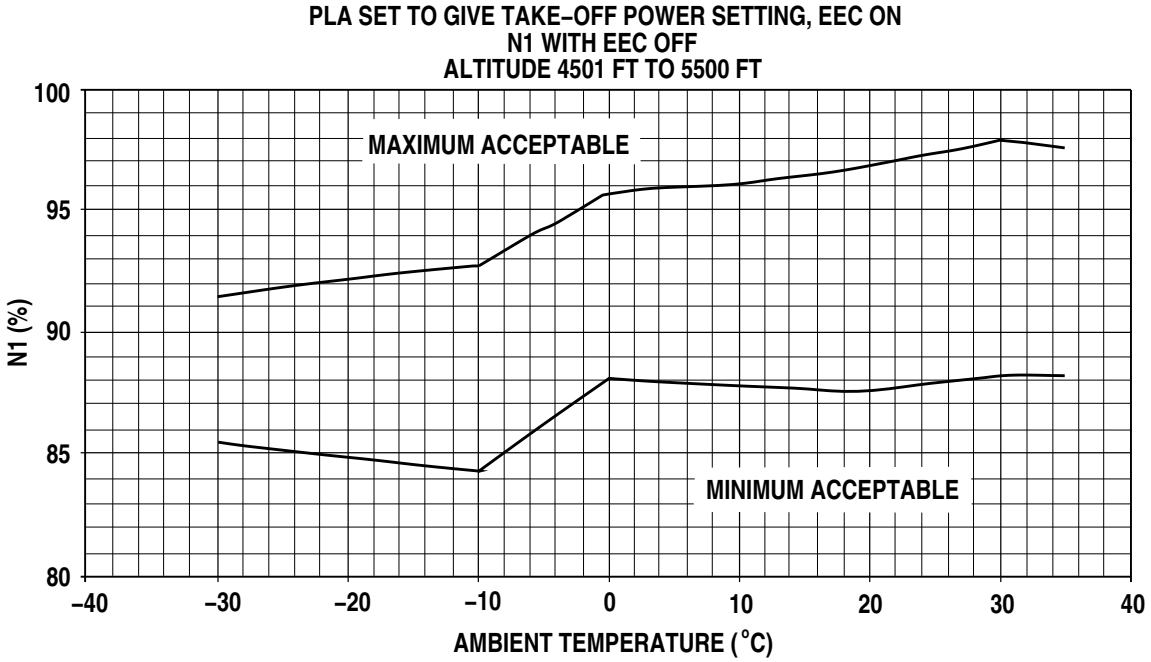

C222388

EEC Authority Limits
Figure 508 (Sheet 3)

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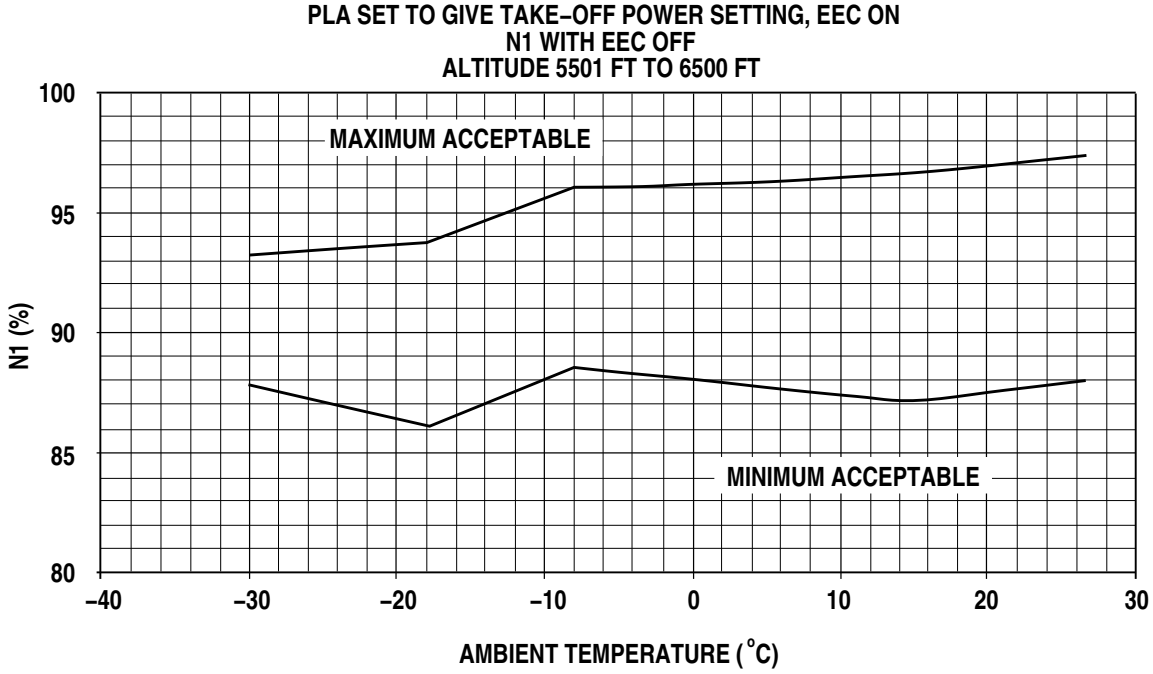

C222389

EEC Authority Limits
Figure 508 (Sheet 4)

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(10) For the given pressure altitude check that N1 is within the acceptable limits for the ambient temperature (Ref. Fig. 508).

(11) If the N1 value is not within the limits, adjust the pressure regulating valve on the HMU to obtain an acceptable N1 in accordance with the appropriate setting chart.

(a) Remove the split pin and adjust pressure regulating valve on the HMU clockwise to reduce and counterclockwise to increase EEC authority.

NOTE: 1. Adjustment must be carried out with engine high rotor at rest.

NOTE: 2. Total travel for pressure regulating valve adjustment: Six turns from stop to stop (¼ turn = 0.75% N1).

(12) Do Steps (2) thru (11) until required EEC authority is obtained.

(13) If an acceptable N1 value cannot be obtained by adjustment, then replace the HMU (Ref. 73-20-02, HYDROMECHANICAL METERING UNIT - MAINTENANCE PRACTICES).

(14) If N1 value is within the limits, do the minimum fuel flow check (Ref. Subpara. J.).

(15) Replace and lock the split pin in HMU pressure regulating valve.

J. Check No.7 - Minimum Fuel Flow (Ref. Figs. 510 and 511)

(1) JT15D-5 (Pre-SB7550 and Post-SB7550) and JT15D-5R engines: confirm that the minimum fuel flow setting will give an N2 speed within the acceptable range of Figure 511 for the particular barometric pressure and ambient temperature in accordance with the procedures which follow:

(2) Remove P3 air tube (4, Fig. 510) as follows:

(a) Remove lockwire securing P3 air delivery tube (4) to combustion chamber drain valve nipple (1) and housing assembly (5) and HMU tee fitting (2).

(b) Loosen coupling nuts on P3 air tube (4). Disconnect and remove air tube from between combustion chamber drain valve nipple (1) and HMU tee fitting (2).

(3) Install suitable blanking cap on combustion chamber drain valve nipple (1).

NOTE: HMU tee fitting (6) must remain open to atmosphere.

(4) Position aircraft into the wind.

(5) Accomplish prestart check (Ref. Para. 19.A.).

(6) Accomplish a satisfactory engine start (Ref. Para. 19.E.).

(7) Select EEC - OFF and allow engine to stabilize for three minutes.

(8) Record N2, barometric pressure and ambient temperature.

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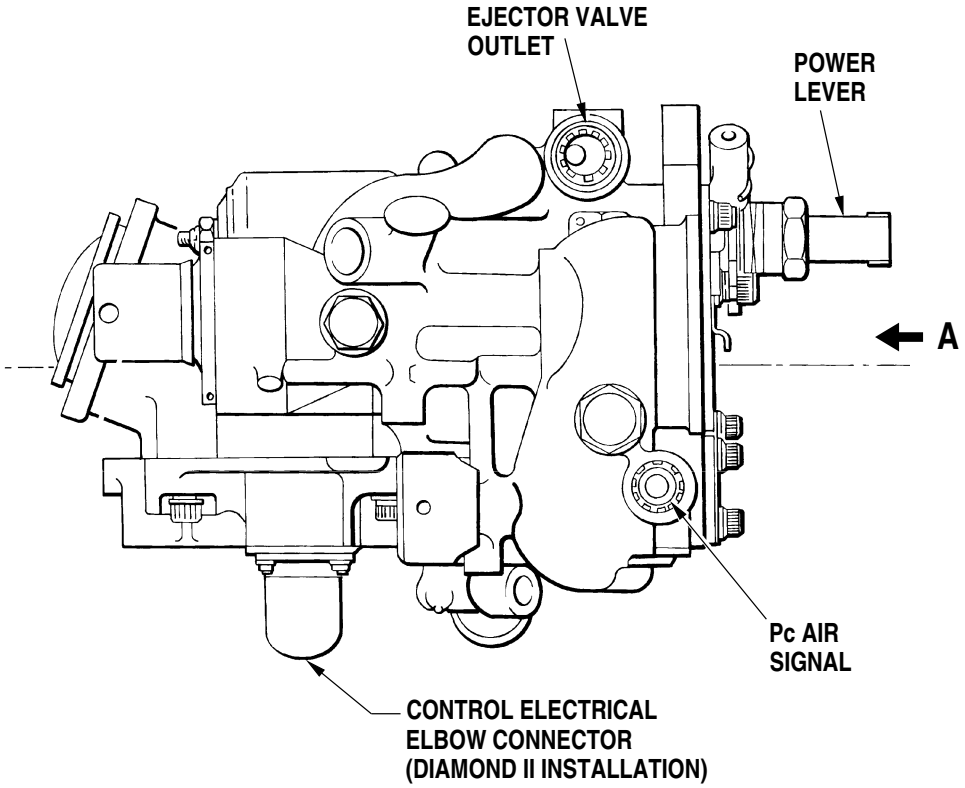

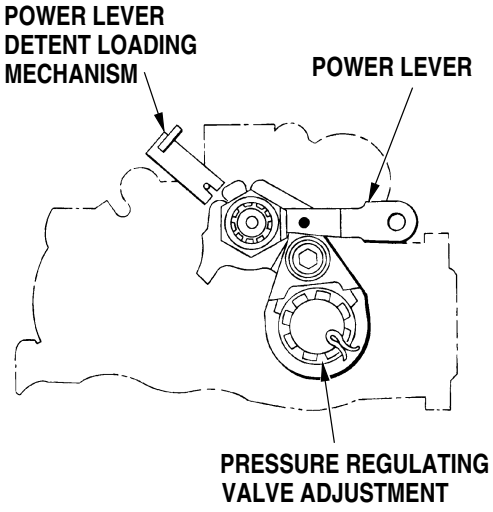

VIEW **A**

C12252B

HMU - External View JT15D-5 (BS657, BS713, and BS1191 Installations)
Figure 509

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(9) Perform engine shutdown (Ref. Para.19.F.).

(10) JT15D-5 (Pre-SB7550 and Post-SB7550) and JT15D-5R engines: compare recorded N2 value with appropriate graph for temperature and pressure altitude on Figure 511. If recorded N2 is outside of specified range, reject and replace HMU. Status of HMU is as follows:

(a) If recorded N2 is within the range specified for Figure 511, reinstall P3 air delivery tube (4) in accordance with step (11).

(b) If recorded N2 is not in the range specified for Figure 511, repeat EEC authority check as per "Check No. 6" in Para. 19. I.; adjust if required. Once EEC authority check is completed and N2 is found within range, repeat minimum flow check. If N2 is still outside of the specified range, please contact your P&WC Customer Solution Representative or the P&WC Customer Support Help Desk immediately at 1-(800)-268-8000. If P&WC recommends removal and replacement of the HMU, please send HMU to:

Pratt & Whitney Canada Corporation
Accessories Repair
2525 Fernand Lafontaine
Longeuil, Quebec
Canada J4N 1N7

(11) Install P3 air tube (4 or 5, Fig. 510):

(a) Remove blanking cap from combustion chamber drain valve (1) nipple (Ref. Fig. 510)

(b) Install P3 air tube (4) or (5) between combustion chamber drain valve nipple (1) and HMU nipple (2) tee fitting (6). Tighten and torque tube (4) or (5) coupling nuts 90 to 100 lb.in. Lockwire tube coupling nuts to HMU nipple (2) or tee fitting (6) , and combustion chamber drain valve and housing assembly (7).

K. Check No. 8 - Secondary Fuel Manifold Pressure Check JT15D-5 (Pre-SB7493 and Pre-SB7526) (Ref. Figs. 512 and 513)

NOTE: 1. Prior to performing the secondary fuel manifold pressure check, refer to Para. 16., Fuel Manifold Pressure Checks - Recommendations.

NOTE: 2. The pressure check reading obtained at engine installation or fuel nozzle set replacement is a reference value. The fuel manifold pressure check is not essential for determining the acceptability of a set of untrended nozzles.

(1) Disconnect and remove fuel manifold secondary pressure fuel tube (Ref. 73-10-09).

(2) Install pressure gage (PWC52161) between exposed flow divider nipple and manifold secondary line elbow. Torque gage connectors 270 to 300 lb.in.

NOTE: Check that gage is operational and correctly calibrated.

(3) Blank off engine cabin bleed air tubes.

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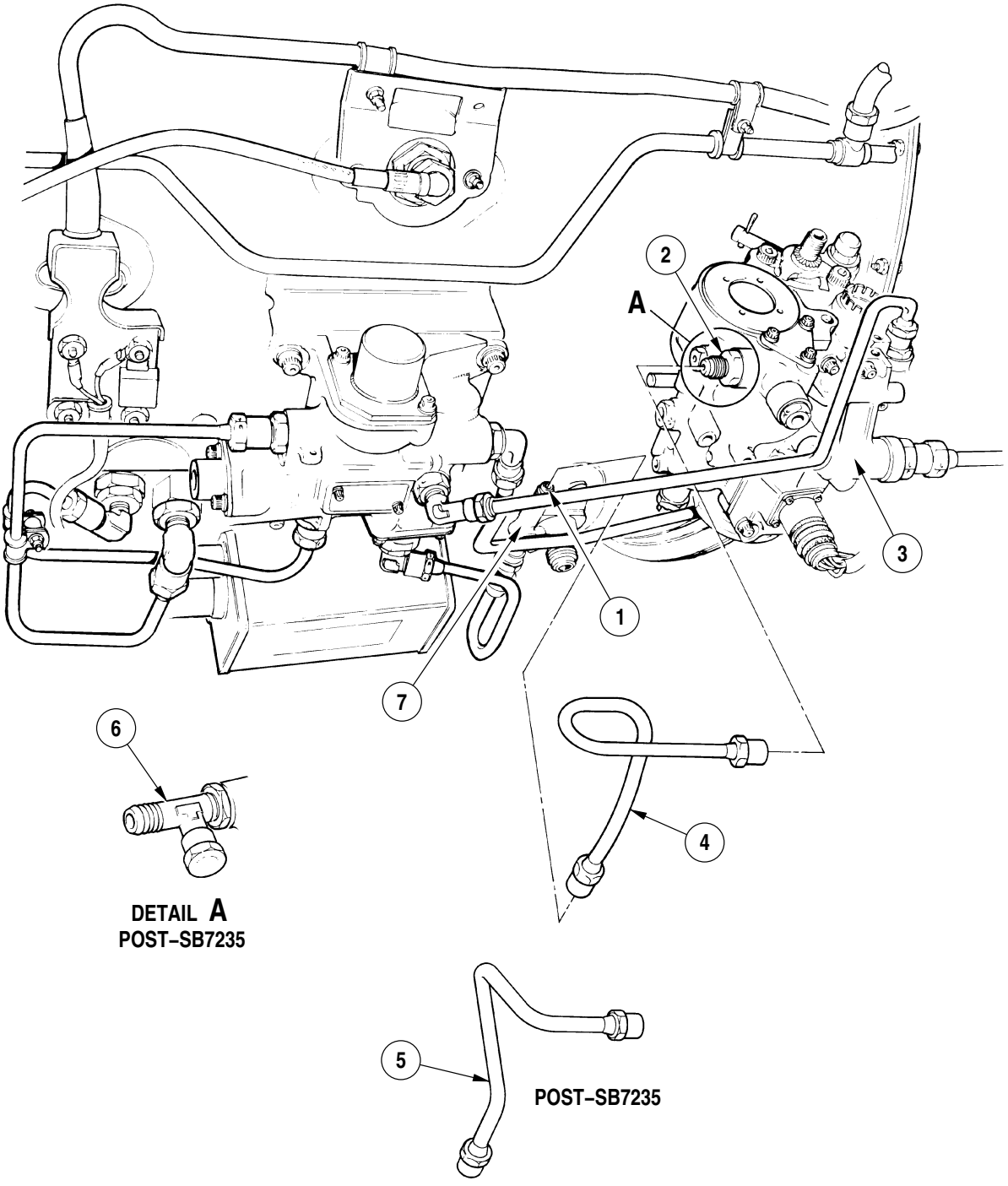

JT15D-5 SHOWN (JT15D-5R SIMILAR) C20170B

HMU Minimum Fuel Flow Adjustment - Removal/Installation of P3 Air Delivery Tube
Figure 510

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Key to Figure 510

1. Combustion Chamber Drain Valve Housing Nipple
2. HMU Nipple, JT15D-5 (Pre-SB7235)
3. HMU
4. P3 Air Delivery Tube, JT15D-5 (Pre-SB7235)
5. P3 Air Delivery Tube, JT15D-5 (Post-SB7235) and JT15D-5R
6. Tee Fitting, JT15D-5 (Post-SB7235) and JT15D-5R
7. Combustion Chamber Drain Valve and Housing Assembly

(4) Accomplish a satisfactory engine start (Ref. Para.19.E.).

(5) Open air valve on pressure gage (PWC52161) and collect purged fuel in a vented container.

(6) Check engine fuel lines and blanked cabin air bleed tube for leaks. If required, shut down engine and correct leaks.

(7) Obtain and record OAT and pressure altitude. Determine takeoff N1% rpm (Ref. Airframe Maintenance Manual).

(8) Set power lever at takeoff value and maintain for three to five minutes. Record gage secondary manifold fuel pressure reading in logbook.

(9) Shut down engine (Ref. Para. 19.F.).

(10) Check that air was purged from pressure gage (PWC52161). If required, purge gage and repeat pressure check.

(11) Remove pressure gage (PWC52161) and install manifold secondary pressure fuel tube (Ref. 73-10-09).

(12) Check that recorded manifold secondary fuel pressure value is within acceptable range (Ref. Fig. 513). If not first manifold check, check engine log book for reference manifold pressure check value.

NOTE: 1. The purpose of the reference value is to allow manifold pressure changes to be monitored.

NOTE: 2. A new reference value is created when a new set of fuel nozzles is installed.

(13) If manifold pressure was acceptable and change from reference value is less than 100 psig, no further action is required.

(14) If manifold pressure reading was not acceptable, or was within acceptable range but indicated a 100 psig or greater change from reference pressure value, determine if HSI is required. Inspect the following using a suitable borescope:

(a) Inspect HP turbine blades through rear of engine (Ref. 72-50-02).

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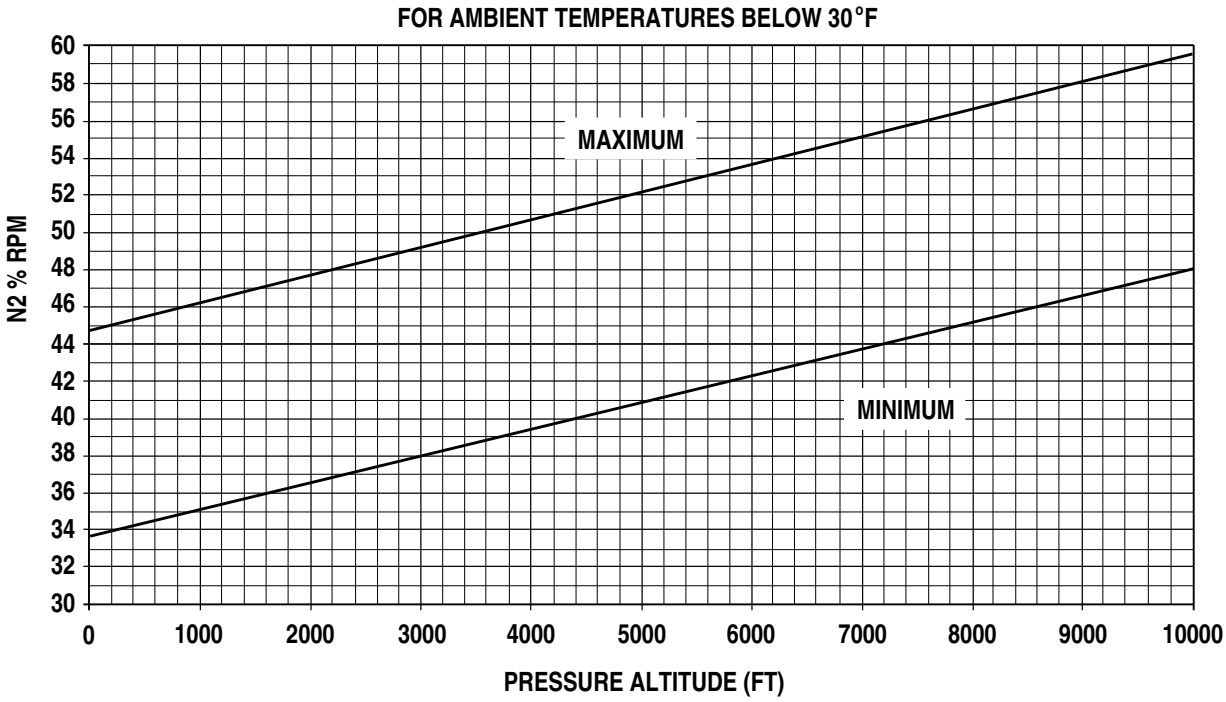

C222391

HMU Minimum Fuel Flow Check - Acceptable N2% rpm
Figure 511 (Sheet 1 of 3)

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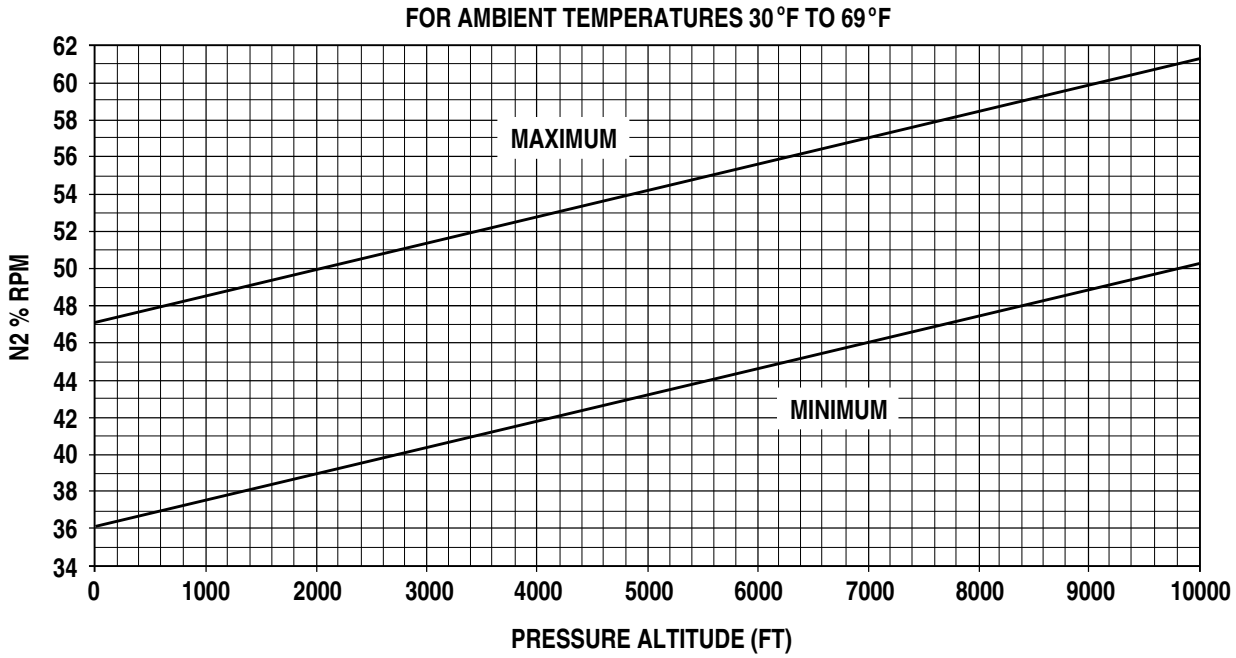

C222390

HMU Minimum Fuel Flow Check - Acceptable N2% rpm
Figure 511 (Sheet 2)

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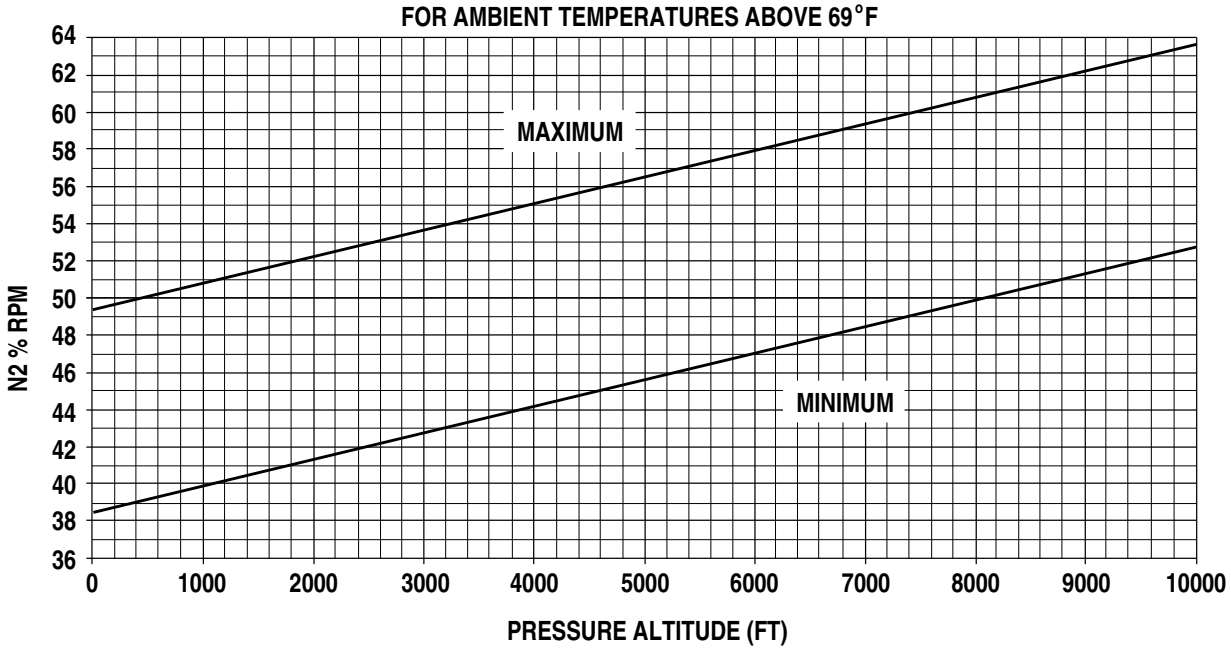

C222392

HMU Minimum Fuel Flow Check - Acceptable N2% rpm
Figure 511 (Sheet 3)

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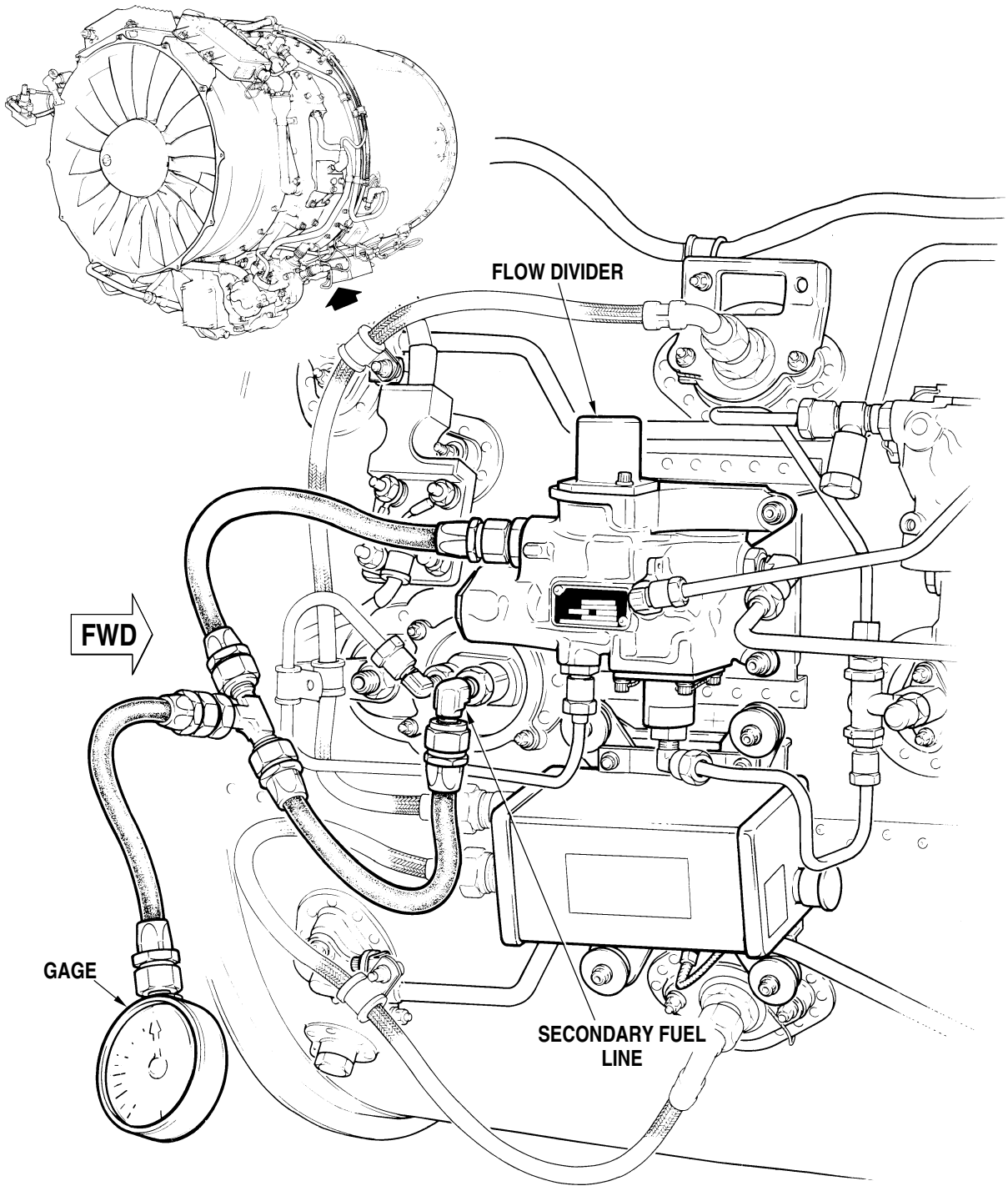

For JT15D-5 (Pre-SB7493 and Pre-SB 7526) Engines Only C24787

Secondary Fuel Manifold Pressure Check - Gage Installation
Figure 512

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(b) Combustion chamber liner inner dome (Ref. 72-40-01).

NOTE: Remove spark igniter (Ref. 74-20-02) for borescope access.

(c) Inspect installed fuel nozzles (Ref. 73-10-05) for the presence of heavy coking.

(15) Perform HSI if required (Ref. 72-00-00, Hot Section Inspection).

L. Primary Fuel Manifold Pressure Check

NOTE: This ground check is associated with Fault Isolation chart 'Slow Acceleration to Idle: JT15D-5 (Post-SB7493/Post-SB7526/Post-SB7598) and JT15D-5R' found in 72-00-00, FAULT ISOLATION.

(1) Check that pressure gage (PWC52161) is operational and correctly calibrated.

(2) Disconnect and remove fuel manifold primary pressure fuel tube between flow divider and primary fuel manifold elbow (Ref. 73-10-09).

(3) Install pressure gage (PWC52161) between exposed flow divider nipple and manifold primary line elbow. Torque gage connectors 90 to 100 lb.in.

NOTE: Pressure gage coupling nut torque values are for oil lubricated threads.

(4) Loosen and remove coupling on secondary manifold fuel pressure tube from flow divider valve secondary manifold fuel flow port (Ref. 73-10-09).

(5) Cap exposed flow divider valve secondary manifold fuel flow port threaded connector.

(6) Blank off engine cabin bleed air tubes.

(7) Record the following during the engine starting sequence:

- Engine starter on (zero time).
- Time to engine ignition.
- Time engine starter is shut off.
- Time to ground idle N2 speed.

(8) Accomplish a satisfactory engine start (Ref. Para.19.E.) using aircraft battery.

(9) Open air valve on pressure gage (PWC52161) and collect purged fuel in a vented container.

(10) Check engine fuel lines and blanked cabin air bleed tube for leaks. If required, shut down engine and correct leaks.

(11) Obtain and record OAT and pressure altitude.

(12) Set power lever to Ground Idle N2 rpm value.

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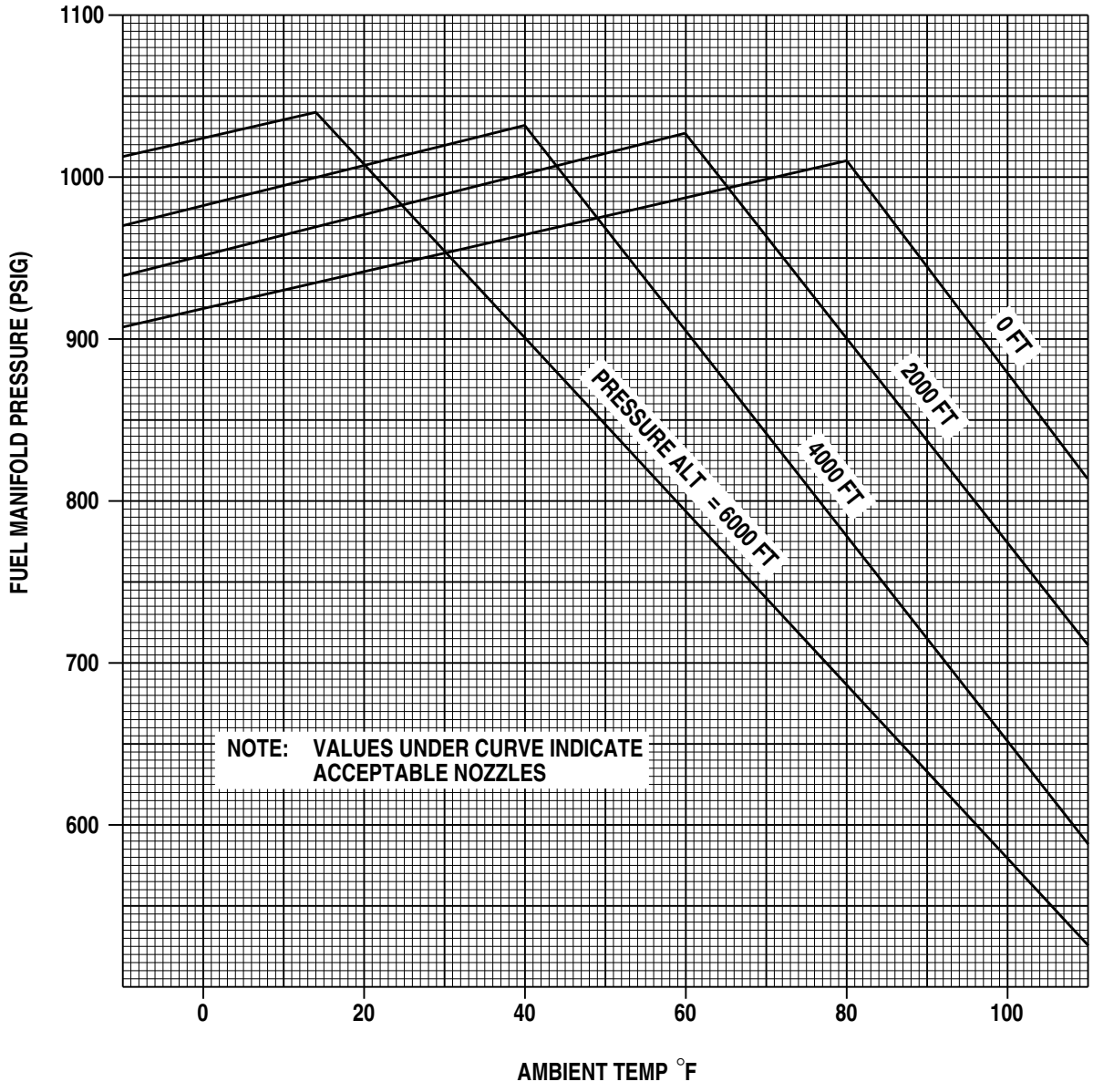
MAXIMUM ALLOWABLE FUEL MANIFOLD PRESSURE AT TAKEOFF RATING

NOTE 1: APPLICABLE TO ENGINES WITH DUPLEX NOZZLES
2: NO CABIN BLEED
3: NO POWER EXTRACTION



For JT15D-5 (Pre-SB7493 and Pre-SB 7526) Engines Only C35004B

Secondary Fuel Manifold Pressure Check - Acceptable Range
Figure 513

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(13) Set throttle to N2 rpm value for pressure altitude and ambient temperature indicated on Figure 514.

(14) Record primary manifold fuel pressure gage (PWC52161) reading in engine logbook.

(15) Shut down engine (Ref. Para. 19.F.).

(16) Check that air was purged from pressure gage (PWC52161). If required, purge gage and repeat pressure check.

(17) Repeat steps (7) through (16) using generator assist for engine starter.

(18) Refer to 72-00-00, FAULT ISOLATION, Slow Acceleration to Idle: JT15D-5 (Post-SB7493/Post-SB7526/ Post-SB7598) and JT15D-5R for maintenance action.

(19) Remove pressure gage (PWC52161) and install manifold primary pressure fuel tube as follows:

(a) Remove residual lubricant on primary pressure fuel tube and mating parts with a clean, lint-free cloth.

(b) Apply a light coat of anti-seize compound (PWC06-009) to threads of mating adapters on FDV and primary manifold elbow. Apply a light coat of same anti-seize compound to thrust face between each pressure fuel tube coupling nut and tube ferrule. Make sure no sealant is applied to adapter/tube coupling conical surfaces or to fluid-carrying bore.

(c) Torque and lockwire each tube coupling nut (Ref. 73-10-09).

(20) Remove cap from flow divider valve secondary manifold fuel flow port threaded connector and install secondary manifold fuel pressure tube (Ref. 73-10-09).

(21) Record nozzle Total Running Time Since New (TTSN) and expected removal dates.

M. Check No.9 - N1 Takeoff Thrust Check

NOTE: This check is to be performed if takeoff N1 thrust cannot be attained, possibly due to HMU fuel schedule set too low. Perform the following procedure every time the HMU/aircraft power lever linkage is adjusted or disturbed.

CAUTION: DO NOT OPERATE ENGINE WHILE CHECKING HMU POWER LEVER POSITION.

(1) Ensure that HMU power lever can reach the maximum takeoff postion as follows:

(a) Manually deploy the spring-loaded ball in the HMU power detent loading mechanism.

(b) Set aircraft throttles to maximum takeoff physical stop and verify whether ball is able to fully engage in the notch in the power lever detent plate. Proceed as follows:

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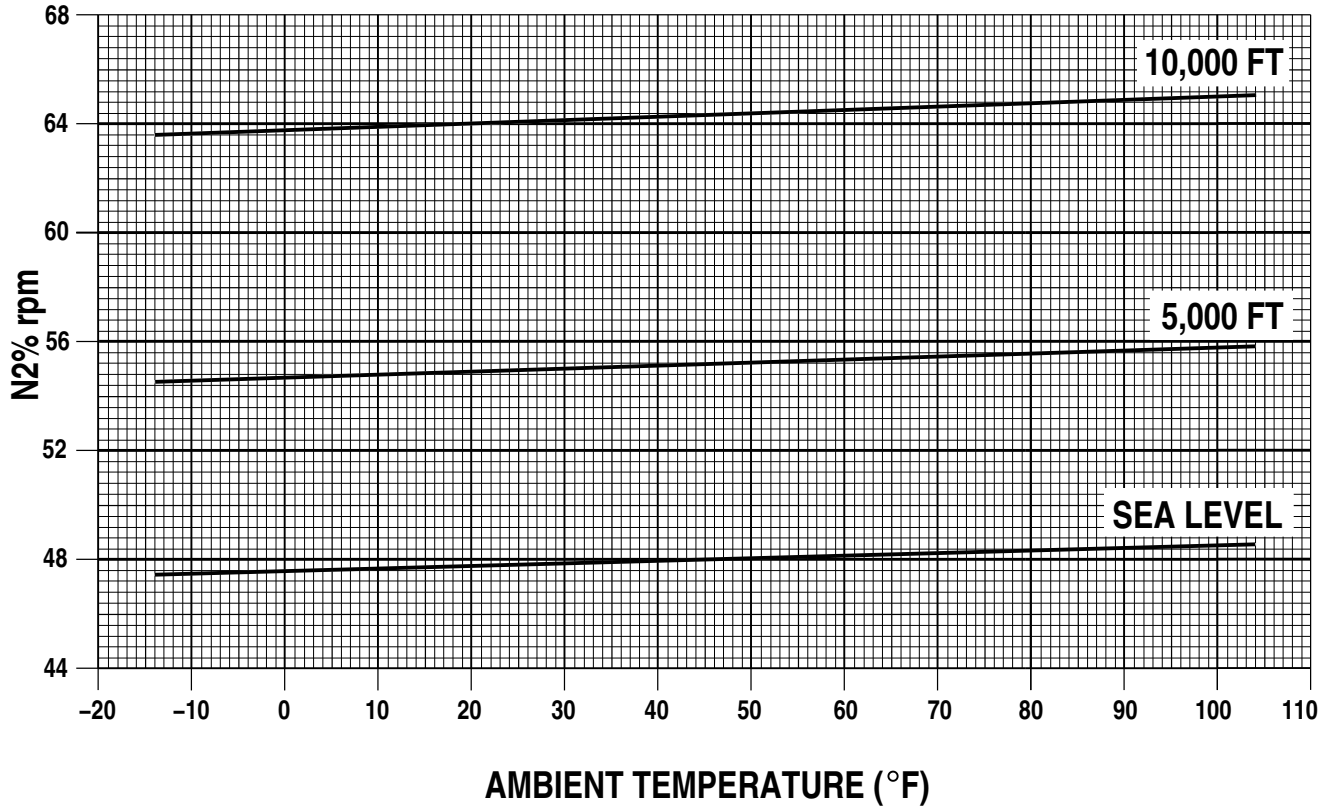

JT15D-5 (POST-SB7526 AND POST-SB7598) AND JT15D-5R C67585A

Primary Manifold Pressure Check - Setting N2 Speed
Figure 514

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1 If ball engages in power lever detent plate notch, proceed to step (2).

2 If ball does not engage in power lever detent plate notch, adjust aircraft power lever rigging in accordance with Airframe Maintenance Manual and proceed to step (2).

(2) Position aircraft into the wind away from the influence of buildings or other obstacles..

(3) Obtain and record local barometric pressure and ambient temperature.

(4) Refer to Airframe Maintenance Manual and obtain rated takeoff N1% rpm value and corresponding maximum N2 and T5 values for local conditions.

(5) Accomplish a prestart check (Ref. Para. 19.A.).

(6) Accomplish a satisfactory engine start (Ref. Para. 19.E.).

(7) Make sure EEC is ON.

CAUTION: DO NOT EXCEED MAXIMUM VALUES OF N1, N2 AND T5 PREVIOUSLY DETERMINED. IF EITHER MAXIMUM VALUE IS EXCEEDED, REFER TO CHAPTER 72-00-00, FAULT ISOLATION, FOR CORRECTIVE ACTION. FOLLOWING RECTIFICATION, REPEAT EEC AUTHORITY CHECK.

(8) Advance power lever to verify if target N1 % rpm value (takeoff power) can be met:

(a) If target takeoff power is met, proceed with next check on Ground Checks table (Ref. Subpara. I.).

(b) If takeoff power cannot be met, advance aircraft throttles to maximum physical stop , record actual N1 value then shut engine down (Ref. Para.19.F.). Refer to step (9).

(9) Maximum recorded N1% rpm value less than target takeoff N1 value:

(a) If maximum recorded N1% rpm value was within -2% of target takeoff N1, HMU presure regulating valve must be adjusted: refer to step (10)).

(b) If maximum recorded N1% rpm value was less than -2% of target takeoff N1, preform Secondary Fuel Manifold Check No. 8 (Ref. Subpara. K.).

(10) HMU pressure regulating valve adjustment and second N1 check:

(a) Remove split pin in HMU pressure regulating valve and adjust clockwise by ⅓ of a turn.

(b) Repeat steps (4) through (7).

(c) Advance power lever to verify if target N1 % rpm value (takeoff power) can be met. Record N1 value achieved.

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(11) If target takeoff N1 % rpm value was achieved, perform EEC Authority Check No. 6 (Ref. Subpara. I.).

(12) If N1% rpm value was greater than value recorded at step (b), but N1 takeoff power is still not available, repeat step (10).

(13) If no increase in N1 rpm is observed, shutdown engine (Ref. Para.19.F.), then perform Secondary Fuel Manifold Check No. 8 (Ref. Subpara. K.).

N. Check 10 - Fuel Pump Inlet Screen Check

(1) Check the fuel pump inlet screen for foreign matter and distortion after an engine ground run (Ref. 73-10-02):

- whenever an engine component upstream of the screen was replaced;
- following an engine change;
- following HSI.

20. On-Aircraft Engine Vibration Analysis and Trim Balance

A. General

Resonant vibration is the major contributor to aircraft cabin noise. Engine vibration causes resonant vibration in aircraft structures, exciting resonance and noise in the cabin. The maintenance philosophy for providing the following procedures is to aid in the reduction of aircraft cabin noise through the reduction of engine vibration.

Using the recommended vibration analysis equipment, engine vibration levels are measured while the engine is installed during a series of engine ground runs. Engine vibration is measured and potentially reduced by adjusting the trim balance weight configuration on the LP compressor (fan) front balance rim. A typical operation includes an initial ground run where a vibration survey is performed and a trim weight solution determined; a second ground run to measure the new vibration signature; and one or more engine runs to verify that engine vibration levels are optimised (Ref. Fig. 515).

The number of engine trim balance counterweights which can be added to the fan forward balance rim is limited. If the maximum limit for the number of LPC trim balance counterweights is exceeded during an engine trim balance operation, or if fan forward balance rim detail and trim balance counterweights cannot be distinguished, then the LPC rotor can be shipped to an approved engine overhaul facility to have all counterweights stripped and to be detail balanced.

If excessive or undesirable cabin noise is present in the aircraft, it is recommended that cabin acoustic readings be taken using microphones according to an approved method, before performing on-wing engine vibration survey and trim balance. The cabin acoustic survey will help determine the source of the excessive noise. If it is suspected that the engine is the cause of excessive vibration and subsequent excessive cabin noise, only the fan may be trim-balanced while the engine is on the aircraft.

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Vibration limits are not provided in the engine maintenance manual because of variances between aircraft installations.

For assistance with engine vibration analysis and fan trim balancing procedure, please contact your local P&WC representative or contact the P&WC Customer Help Desk (see INTRODUCTION - Customer Support at the front of this Engine Maintenance Manual).

21. On Aircraft Engine Vibration Analysis and Trim Balance using ACES Model 1700 Equipment

A. Check Engine LP Compressor Trim Balance Weight Configuration

(1) Remove the engine LP compressor inlet cone (Ref. 72-30-03, MAINTENANCE PRACTICES).

(2) Refer to 72-30-03, MAINTENANCE PRACTICES - Removal/Installation for fan balance weight location and coding information.

CAUTION: DO NOT OMIT THIS STEP.

(3) Observe and record the classes and locations of all detail balance and fan trim balance counterweights locations on the fan forward balancing rim in relation to the fan index mark. For recording purposes, the 40 possible balance rim rivet hole locations are counted counterclockwise from the fan 12 o'clock position index mark as observed while looking to the rear of the engine.

NOTE: 1. LP compressor rotor unbalance is corrected by the installation of trim balance counterweight(s) to the fan forward balance rim by using a maximum of eight counterweights, including those used for detail balancing.

NOTE: 2. The trim balance counterweight mass and position defined by the ACES analyzer is called the solution.

NOTE: 3. The ACES analyzer software only calculates and confirms trim balance counterweight and mass location solutions which are to be added to fan forward balance rim, and does not provide solutions which require removal of existing trim balance counterweights.

NOTE: 4. Fan trim balance and detail balance weight locations on the fan front balance rim are entered into ACES Analyzer during the fan trim balancing procedure so that trim balance weight solution provided by the analyzer does not conflict with existing LPC rotor detail balance configuration.

(4) Compare trim and detail balance counterweight information recorded at step (3) to information from engine trim data plate and engine logbooks.

(5) Reinstall the LP compressor inlet cone (Ref. 72-30-03, MAINTENANCE PRACTICES).

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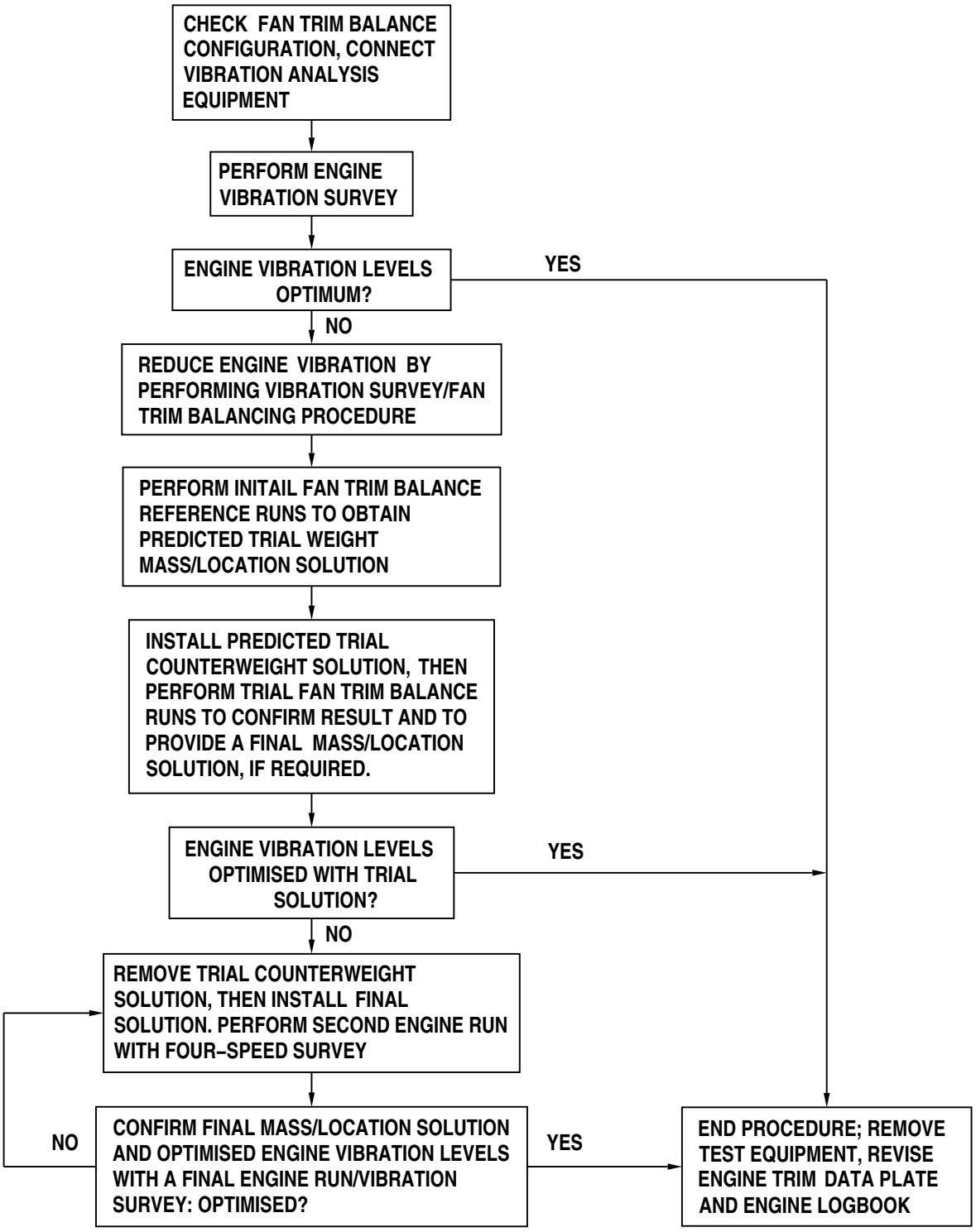
CHECK FAN TRIM BALANCE CONFIGURATION, CONNECT VIBRATION ANALYSIS EQUIPMENT
PERFORM ENGINE VIBRATION SURVEY
ENGINE VIBRATION LEVELS OPTIMUM?
YES
NO
REDUCE ENGINE VIBRATION BY PERFORMING VIBRATION SURVEY/FAN TRIM BALANCING PROCEDURE
PERFORM INITAIL FAN TRIM BALANCE REFERENCE RUNS TO OBTAIN PREDICTED TRIAL WEIGHT MASS/LOCATION SOLUTION
INSTALL PREDICTED TRIAL COUNTERWEIGHT SOLUTION, THEN PERFORM TRIAL FAN TRIM BALANCE RUNS TO CONFIRM RESULT AND TO PROVIDE A FINAL MASS/LOCATION SOLUTION, IF REQUIRED.
ENGINE VIBRATION LEVELS OPTIMISED WITH TRIAL SOLUTION?
YES
NO
REMOVE TRIAL COUNTERWEIGHT SOLUTION, THEN INSTALL FINAL SOLUTION. PERFORM SECOND ENGINE RUN WITH FOUR–SPEED SURVEY
CONFIRM FINAL MASS/LOCATION SOLUTION AND OPTIMISED ENGINE VIBRATION LEVELS WITH A FINAL ENGINE RUN/VIBRATION SURVEY: OPTIMISED?
NO
YES
END PROCEDURE; REMOVE TEST EQUIPMENT, REVISE ENGINE TRIM DATA PLATE AND ENGINE LOGBOOK

C86438A

Typical Engine Vibration Survey and Fan Trim Balancing Operation Using ACES Model Equipment
Figure 515

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B. Installation of ACES Model 1700 Equipment

NOTE: 1. The solutions provided by the ACES analyzer assume that counterweights are added to balance the existing trim balance configuration.

NOTE: 2. The equipment in procedures below has been approved for use in determining position and mass of trim balance weight. Other equipment may be approved on a case-by-case basis.

NOTE: 3. Accomplish vibration survey and fan trim balance operation using the following procedures and the ACES Operator's Manual. The operator must be familiar with the ACES Model 1700 analyzer before performing these operations.

NOTE: 4. The Airframe Maintenance Manual should be consulted to determine when engine in situ trim balance should be performed.

NOTE: 5. ACES analyzer software may be updated.

NOTE: 6. The face plate on later versions of the of the ACES Collector Analyer Plus, Model 1700 device. This instruction reflects keypad selections from the latest version of the analyzer.

(1) Put speed conditioning unit (SCU) 10-100-0485 and ACES Model 1700 analyzer Z1700-110V in aircraft cockpit (Ref. Fig. 516).

(2) Connect Model 517P SCU 10-100-0485 COMM port to COMM port on ACES Model 1700 analyzer with communication cable 10-320-0180.

(3) Connect Model 517P SCU 10-100-0485 TACH port to ACES Model 1700 analyzer TACH port with tachometer cable 10-320-0181.

(4) If it is preferred to perform a vibration survey only, refer to the alternate equipment installation in step (9) and on Figure 516.

NOTE: For alternate procedure to perform a vibration survey only, it is not necessary to remove the inlet cone or to install any optical tachometer equipment.

(5) For ACES Phototach optical tachometer (Ref. Figs. 516 and 517):

(a) Locate index mark on nose cone rim. For reference, the No.1 fan blade is at or counterclockwise beside the index mark.

NOTE: 1. The LP compressor rotates counterclockwise as viewed from the front of the engine looking rearward.

NOTE: 2. Trim balance counterweight angular locations are counted clockwise from the nose cone index mark.

NOTE: 3. Trim balance counterweight fan balance rim rivet holes are counted counterclockwise from the inlet cone index mark.

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(b) Position No. 1 blade at the 12 o'clock position.

(c) Clean an area behind the inlet cone weld radially and clockwise from inlet cone index mark. Attach a two-inch strip of reflective tape (PWC05-238) on the cleaned part of the inlet cone. Do not cover inlet cone anti-icing holes, and ensure there are no air bubbles trapped under the tape.

(d) For quick reference, mark a line corresponding to reflective tape leading edge on fan blade platform using a metal marking crayon (PWC05-018).

(e) Remove T1 thermocouple probe and housing from aircraft nacelle (Ref. Airframe Maintenance Manual).

(f) Secure mounting bracket 22-430-0058 to Tl thermocouple probe housing on nacelle. Secure optical tachometer 10-100-1773 to mounting bracket.

CAUTION: SECURE CABLE TO PREVENT INGESTION IN ENGINE.

CAUTION: KEEP CABLE FROM TOUCHING HOT P3 BLEED AIR AND OIL LINES.

(g) Connect 50 ft. tachometer extension cable 10-320-0126 from optical probe connector to PHOTO port on Model 517P SCU 10-100-0485.

(6) For ACES Lasetach Optical Tachometer (Ref. Figs. 516 and 517):

(a) Locate index mark on nose cone rim. For reference, the No.1 fan blade is at or counterclockwise beside the index mark.

NOTE: 1. The LP compressor rotates counterclockwise as viewed from the front of the engine looking rearward.

NOTE: 2. Trim balance counterweight angular locations are counted clockwise from the inlet cone index mark.

NOTE: 3. Trim balance counterweight fan balance rim rivet holes are counted counterclockwise from the inlet cone index mark.

(b) Position No. 1 blade at 12 o'clock position.

(c) Clean the areas on either side of the No.1 blade leading edge from the blade platform to a point approximately one or two inches above the blade platform. Attach a two-inch strip of reflective tape (PWC05-238) radially to the cleaned area of the No.1 blade and allow ¼ inch of tape to fold over the No.1 blade leading edge.

(d) Secure Lasetach mounting bracket 10-100-0196 and Lasetach unit 10-100-1300 to aircraft wing directly forward of engine.

CAUTION: SECURE CABLE TO PREVENT INGESTION IN ENGINE.

(e) Connect 50 ft. tachometer extension cable 10-320-0126 from Lasetach connector to PHOTO port on Model 517P SCU 10-100-0485.

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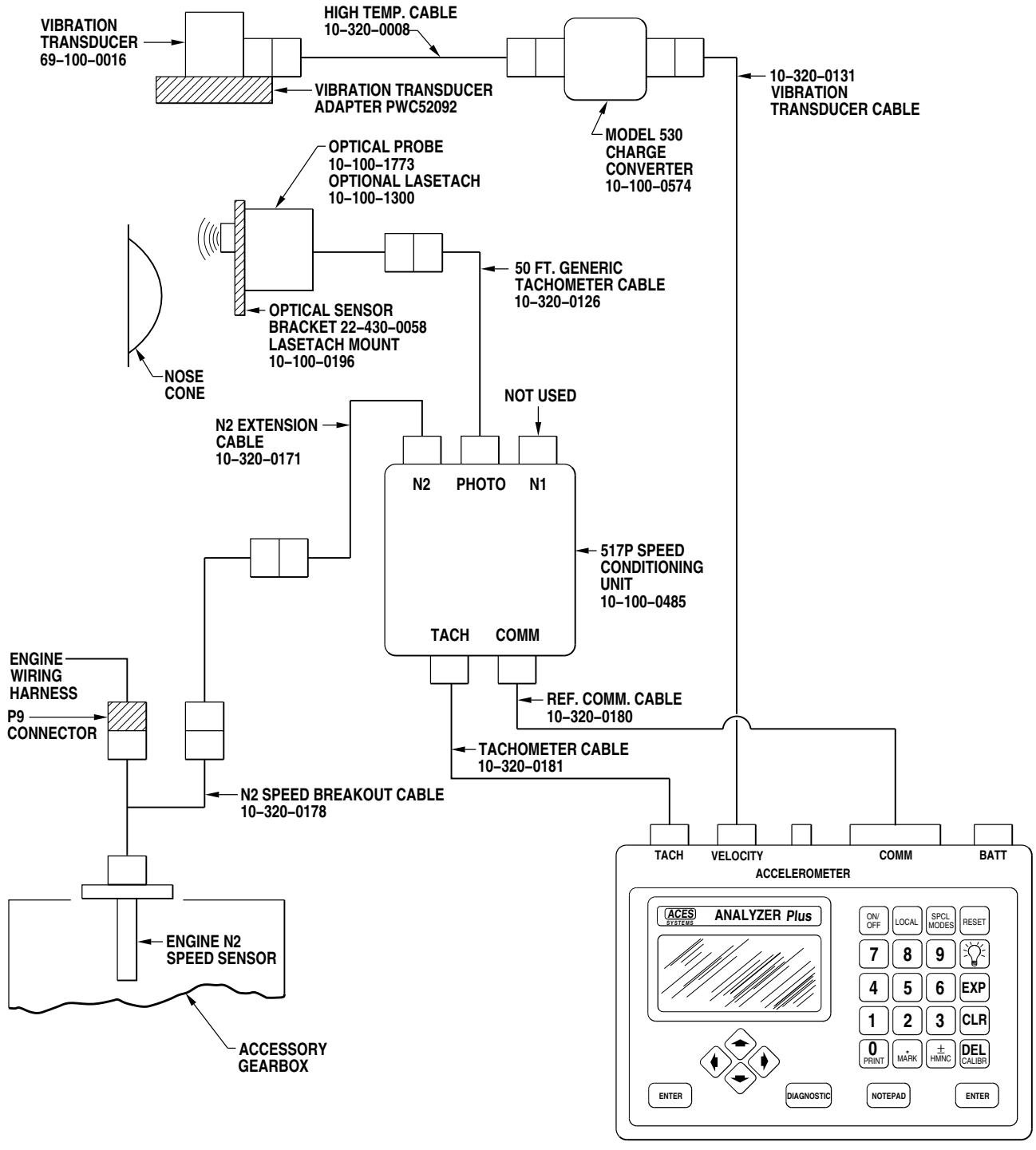

T.E.C. ACES MODEL 1700 PLUS ANALYZER

FOR VIBRATION SURVEY AND TRIM BALANCE OPERATIONS C68771B

Installation of ACES Model 1700 Analyzer Equipment - Schematic
Figure 516 (Sheet 1 of 2)

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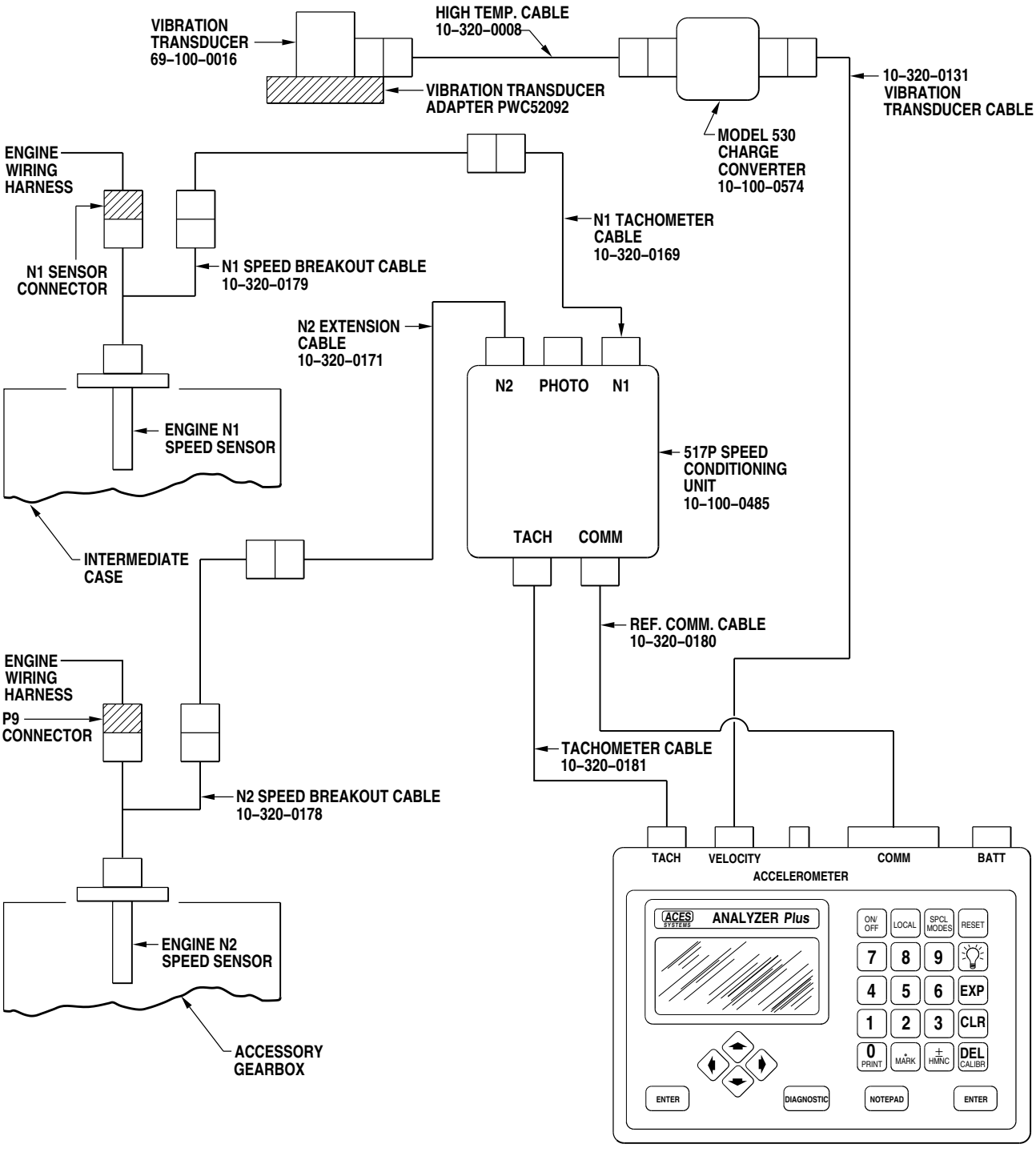

T.E.C. ACES MODEL 1700 PLUS ANALYZER

ALTERNATE OPERATION FOR VIBRATION SURVEY ONLY C70206A

Installation of ACES Model 1700 Analyzer Equipment - Schematic
Figure 516 (Sheet 2)

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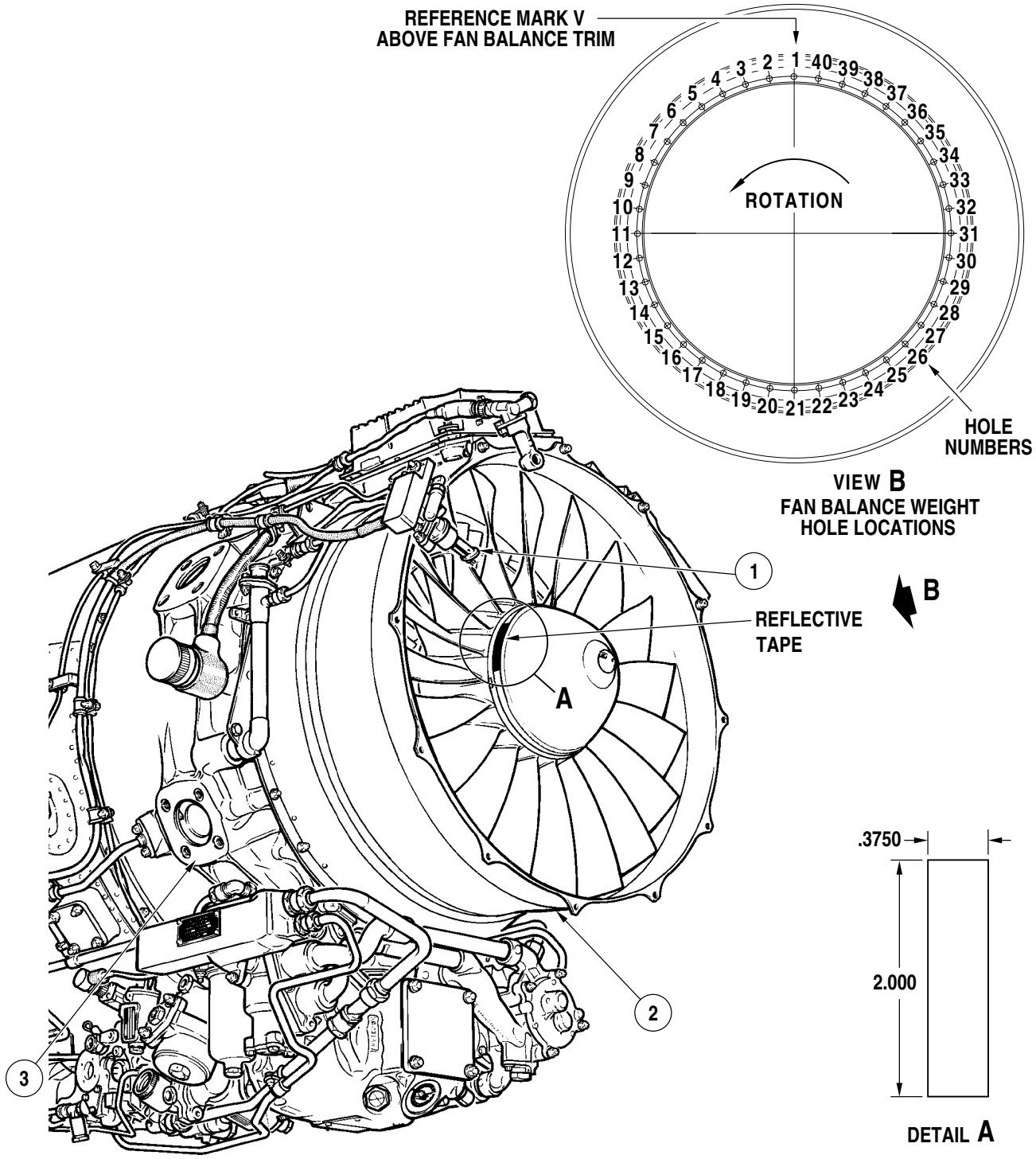

FOR OPTICAL TACHOMETER INSTALLATION C31272B

Installation of Inlet Cone Reflective Tape
Figure 517

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Key to Figure 517

1. T1 Sensor
2. LP Compressor Case
3. Intermediate Case

(7) Install vibration transducer (Ref. Figs. 516 and 518):

(a) Remove three screws (2) and plate (1) from vibration transducer pad (7) on intermediate case.

(b) Secure adapter (3) (PWC52092) to vibration transducer pad (7) with three screws (2).

(c) Secure vibration transducer 69-100-0016(4) on adapter (3) (PWC52092) with three screws (3). Torque screws 17 to 19 lb.in.

(d) Connect vibration transducer and Model 530 charge converter 10-100-1500 with high temperature cable 10-320-0008.

(e) Connect Model 530 charge converter 10-100-0574 to ACES Model 1700 analyzer VELOCITY port using vibration transducer cable 10-320-0131.

CAUTION: SECURE CABLES TO PREVENT INGESTION IN ENGINE.

(8) Install N2 breakout cable line (Ref. Fig. 516):

(a) Disconnect engine wiring harness P9 N2 speed sensor connector (Ref. 73-20-05, MAINTENANCE PRACTICES).

NOTE: The N2 signal from the P9 connector is sent to the aircraft cockpit. The P9 connector is on the harness cable that is not bundled with the EEC interrogation plug.

(b) Connect N2 breakout cable 10-320-0178 to exposed engine wiring harness and N2 speed sensor connectors.

(c) Connect N2 breakout cable 10-320-0178 to N2 port on speed conditioning unit 10-100-0485 with N2 extension cable 10-320-0171.

(9) Alternate operation if vibration survey only is to be performed:

(a) Disconnect engine wiring harness N1 speed sensor cable from N1 speed sensor sensor (Ref. 73-20-05, MAINTENANCE PRACTICES).

(b) Connect N1 breakout cable 10-320-0179 to exposed engine wiring harness and N1 speed sensor connector.

(c) Connect N1 breakout cable 10-320-0179 to N1 port on speed conditioning unit 10-100-0485 with N1 extension cable 10-320-0169.

(d) Proceed to step (10).

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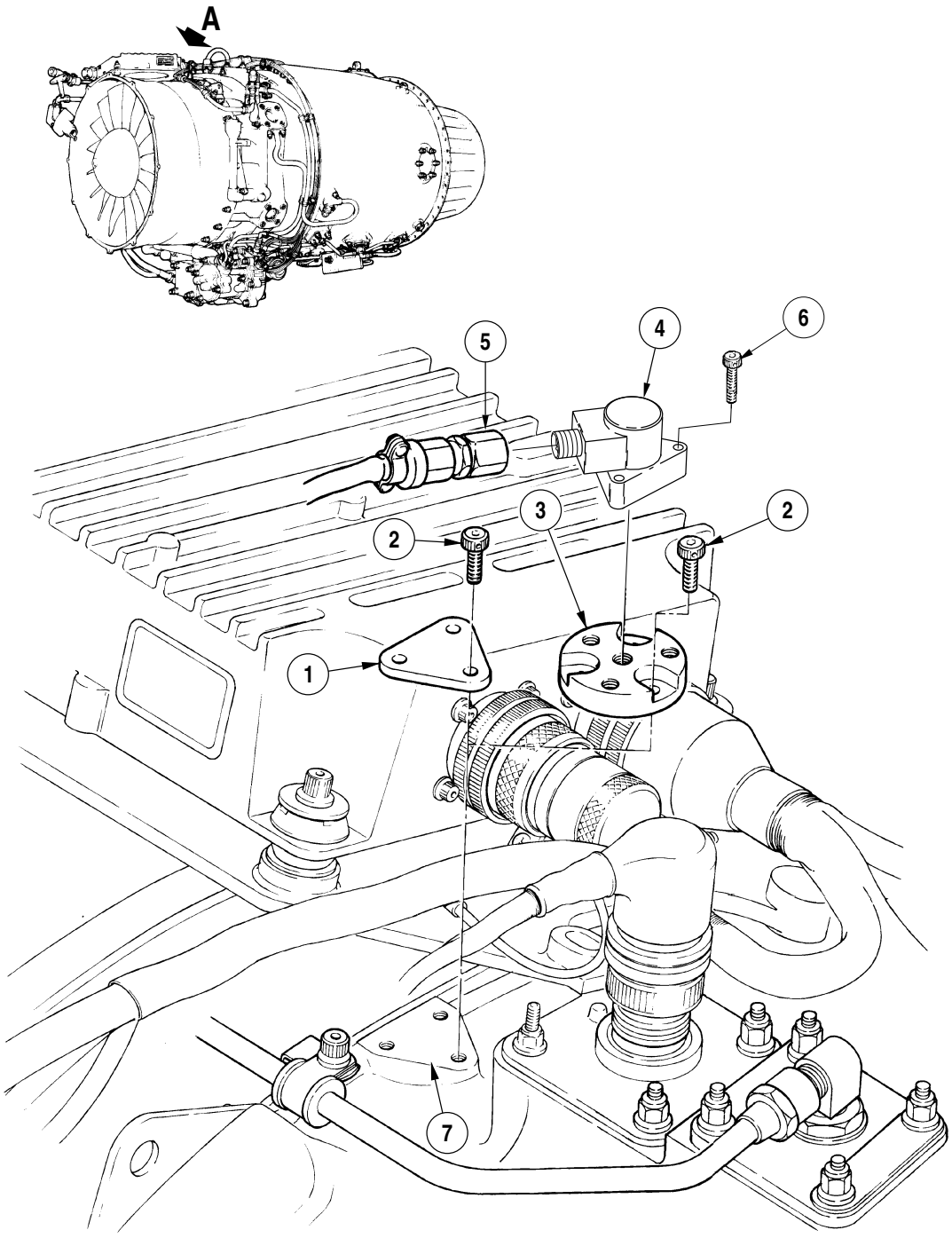

VIEW A

C22901B

Installation of Vibration Transducer
Figure 518

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Key to Figure 518

1. Plate
2. Screw
3. Vibration Transducer Adapter
4. Vibration Transducer
5. Vibration Transducer Cable
6. Screw
7. Vibration Transducer Pad

(10) Select ACES Model 1700 analyzer power button to ON and check that tachometer triggers when No. 1 blade is at TDC. The green GATE light on top of the Lasetach unit or the red LED on the back of the Phototach unit will illuminate when the tape is in the beam of light from the unit. Proceed to Subpara. C..

C. Check ACES Model 1700 Battery Charge

(1) Check that analyzer battery is charged. Whenever possible the battery should be charged to 100% prior to starting a survey, but never less than 75%. Check the battery as follows:

(a) Turn the analyzer ON.

(b) When the Operations Options Menu appears, press the SPCL MODES key.

(c) From the SPECIAL MODES menu, select “2-Test System” and press ENTER.

NOTE: The ACES Model 1700 analyzer has two ENTER keys to accomodate a right-handed or a left-handed operator.

(d) From the Test System Menu, select “2-Measure Internal Battery”

(e) The battery charge will be displayed on screen. Charge the battery if required.

(f) Press the RESET key to return to the Operations Options Menu and continue.

D. Reviewing, Storing and Compressing Previous Vibration Surveys

(1) From the Operations Options Menu, select “PWC Fan Vib Survey” and press ENTER.

(2) When the Main Menu is displayed, select “1-Perform Engine Survey” and press ENTER.

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(3) When the Engine Survey Menu is displayed, select “2-Review Engine Survey” and press ENTER. Watch the screen and take note of the momentary message indicating how many surveys are available. If you have more than one or two surveys stored, you should print or download the surveys and delete the stored data. This will ensure sufficient memory is available to perform another survey without delays or possible errors caused by a lack of available RAM. If you do not wish to delete the data, ensure all stored data is compressed as a minimum precaution. Compressing a single survey will reduce the required storage space by approximately 85%. To **compress a survey** or to **erase data**, do the following:

(a) From the Review Survey Menu, select “1-View Survey” and press ENTER. You may review the information on all available surveys by pressing the UP ARROW or DOWN ARROW keys to scroll through them. If you intend to preserve any of the surveys, make note of the information identifying it from these screens.

(b) From any of the View Survey information screens, you may return to the Survey Menu by pressing the ENTER key, then selecting “9-Return To Survey Menu”.

(c) To Compress a survey, select “5-Compress Survey” and press ENTER. Use the DOWN ARROW key to scroll through the available surveys. When the data screen for the survey you wish to compress is displayed, press ENTER. The screen will display the message “PROCESSING DATA PLEASE STAND BY” and begin the compression process. When compression is complete, the screen will display the message “SAVING SPECTRUM”. This action will restore approximately 87% of the total memory required to collect the data.

(d) From the Review Survey Menu, it is also possible to choose to erase all surveys (recommended if possible). This will free all memory not occupied by the loaded procedures and allow maximum trouble-free performance.

(4) Press the RESET key to return to the Operations Options Menu and begin a new survey.

E. Engine Vibration Survey: ACES Model 1700

NOTE: Accomplish vibration survey and fan trim balance operation using the following procedures and the ACES Operator’s Manual. The operator must be familiar with the ACES Model 1700 analyzer before performing these operations.

(1) Check battery charge (Ref. Subpara. C.). Make sure the battery charge indication is more than 75%. If not, charge battery.

(2) Determine engine maximum N1% rpm for local pressure altitude and ambient temperature.

(3) Load RAM procedure card 75-200-001 into ACES Model 1700 analyzer. Switch power to analyzer to ON, then load the procedure from the card into the analyzer. When the loaded procedure is displayed by the Operation Options menu, switch power to analyzer to OFF, then remove the RAM procedure card 75-200-001.

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(4) Switch power to analyzer back to ON.

CAUTION: MAKE SURE THE INFORMATION ON THE ANALYZER SCREEN IS CORRECT BEFORE PRESSING ENTER.

(5) At Operation Options menu, select JT15D engine family using the DOWN ARROW key and press ENTER.

NOTE: Instructions for use of the ACES Analyzer Model 1700's arrow keys are displayed at the bottom of the ACES analyzer screen.

(6) Select JT15D-5 engine model using the RIGHT ARROW key and press ENTER.

(7) At the Main Menu, select PERFORM ENGINE SURVEY and press ENTER.

(8) Select START ENGINE SURVEY.

(9) At Survey Information panel, enter the engine serial number as follows:

(a) Use the RIGHT ARROW or DOWN ARROW keys to enter the first three letters/numbers on the left. Use the RIGHT ARROW or DOWN ARROW keys to scroll up and down. Use the RIGHT ARROW or DOWN ARROW keys to move to the left or right.

(b) Press the lower RIGHT ARROW or DOWN ARROW key to move to the last three numbers.

(c) When the area for last three numbers is highlighted, press CLR and use the number keys to enter the remainder of the engine serial number.

(d) Select the Vibration Sensor at END-6222, and set the Input Range to AUTORANGE.

NOTE: Use the DOWN ARROW key to move down the menu, and the RIGHT ARROW key to view the options.

(e) At the TACH SOURCE field, select "Optical W/517".

(10) Press ENTER to start recording vibration survey from the following reference engine run.

CAUTION: DO NOT EXCEED ENGINE OPERATING LIMITS. MAINTENANCE MANUAL ENGINE OPERATING LIMITS SUPERSEDED ANY INSTRUCTION IN ACES ANALYZER PROGRAM.

(11) Perform engine start procedures (Ref. Para. 19., Engine Ground Checks). Allow engine to stabilize at ground idle speed and engine oil temperature to reach a minimum of 125°F. Press ENTER.

(12) When Measurement Data vibration spectrum graph is displayed, adjust scale to between 0.8 to 1.2 inch/second using down arrow key. Start a three minute engine run to accelerate engine slowly from ground idle to maximum N1% for the day (takeoff power). When takeoff N1% is reached, press ENTER.

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(13) End vibration survey after engine reaches N1 takeoff power. Press ENTER to stop the analyzer recording.

(14) When the analyzer displays the FAN ENGINE ORDER graph, adjust the scale as required using the lower RIGHT ARROW or DOWN ARROW key.

(15) At 'Save This Survey?' prompt, select YES.

(16) Return the engine to ground idle speed. Press ENTER.

(17) Select REVIEW ENGINE SURVEY from Main Menu using the DOWN ARROW key.

(18) Select VIEW SURVEY using the RIGHT ARROW or DOWN ARROW keys, press ENTER.

(19) Use the RIGHT ARROW key to locate the peak amplitude.

(20) Review stored vibration survey plot and record peak 1EN1 amplitude from the 13800 to 16500 rpm range.

NOTE: Note the N1 rpm corresponding to peak vibration level. It is used to establish a baseline rpm for later four-point engine vibration surveys.

(21) Exit to REVIEW ENGINE SURVEY menu.

(22) Select Return to Survey menu using the DOWN ARROW key.

(23) Exit to the Main Menu on the ACES analyzer.

(24) If trim balance operation is not to be performed immediately, shut down engine (Ref. Para. 19., Engine Ground Checks).

(25) Continue or terminate the current balancing operation as follows:

(a) If a previously started balancing operation was not completed, the message "A new balance job will terminate current job, (Use Resume to Restart)" will display at the bottom of the screen and a question is posted reading "O.K. to Proceed?" followed by a toggle answer YES or NO.

(b) To terminate the old balancing operation and proceed with the new balancing operation you just started, toggle the answer field to YES, then press ENTER.

(c) To complete the previously started job, use the RIGHT ARROW key to to toggle the answer to NO. The screen will return to the FAN BALANCE menu page where you may select "RESUME" to complete the job in progress.

F. Reference Fan Trim Balancing Run: ACES Model 1700

NOTE: The ACES analyzer will display a predicted trial trim balance solution during this operation.

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CAUTION: MAKE SURE THE INFORMATION ON THE ANALYZER SCREEN IS CORRECT BEFORE PRESSING ENTER

(1) At the Operation Options menu, select JT15D engine family using the DOWN ARROW key and press ENTER.

(2) Select the JT15D-5 engine model using the RIGHT ARROW key and press ENTER.

(3) At the Main Menu panel, select BALANCE FAN using the DOWN ARROW key and press ENTER.

(4) At the FAN BALANCE menu, select START BALANCE PROCEDURE using the DOWN ARROW key and press ENTER.

NOTE: The new balance job will terminate the current job. Use RESUME TO START if you are balancing an engine for the first time. Answer YES to the question OK TO PROCEED. If you want to review a previous job, answer NO and press ENTER.

(5) At Balance Information Menu, enter the engine serial number as follows:

(a) Use the RIGHT ARROW or DOWN ARROW keys to enter the first three letters/numbers on the left. Use the RIGHT ARROW or DOWN ARROW keys to scroll up and down. Use the RIGHT ARROW or DOWN ARROW keys to move to the left or right.

(b) Press the lower RIGHT ARROW or DOWN ARROW key to move to the last three numbers.

(c) When the area for last three numbers is highlighted, press CLR and use the number keys to enter the remainder of the engine serial number.

(d) Select the Vibration Sensor at END-6222, and set the Input Range to AUTORANGE.

NOTE: Use the DOWN ARROW key to move down the menu, and the RIGHT ARROW key to view the options.

(e) At the TACH SOURCE field, select “Optical W/517” then press ENTER.

(6) The next screen will confirm target takeoff N1 rpm and percentage. Select YES if correct and press ENTER. At the Fan Balance Speed menu use the number keys to set balancing operation speed to the N1 rpm value corresponding to the previously recorded peak vibration level. Press ENTER.

NOTE: The ACES analyzer will calculate the N1 rpm value as a percentage value.

(7) At the Fan Run 1 panel, ’Label Detail Weight Holes’ will be prompted. Push ENTER.

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(8) At the next screen, counterweight hole locations numbered 1 to 40 are displayed. Input the location of all trim and detail balance counterweights on the fan front balancing rim recorded at step A.(3). Use the DOWN ARROW key to select the hole numbers and the RIGHT ARROW key to activate the existing counterweight location.

NOTE: When selected, an "X" appears at the balance rim counterweight location on the screen.

(9) Select CURSOR HERE WHEN DONE and press ENTER.

(10) The ACES analyzer will review and display the number and locations of counterweights and the prompt "RELABEL HOLES?" so that step (8) input can be checked.

(11) Select NO if the displayed locations are correct and you wish to proceed. Answer YES if corrections are required, then make required corrections per step (8)). The analyzer will prompt the operator to start the engine.

CAUTION: DO NOT EXCEED ENGINE OPERATING LIMITS. AIRFRAME MAINTENANCE MANUAL ENGINE OPERATING LIMITS SUPERSEDED ANY INSTRUCTION IN ACES ANALYZER PROGRAM.

(12) Perform engine start procedures (Ref. Para. 19., Engine Ground Checks). Allow engine to stabilize at ground idle speed and engine oil temperature to reach a minimum of 125°F. Press ENTER.

(13) The analyzer will display the N1 speed in rpm that corresponds to the previously recorded peak engine vibration level. Bring the engine to N1 rpm matching peak vibration level minus 800 rpm and press ENTER.

NOTE: This N1 rpm value will be described as the **baseline**. Engine vibration levels at four additional N1 rpm values above the baseline rpm, 200 rpm apart, are to be recorded using the analyzer.

(14) At the next display, allow 10 to 15 seconds for the phase and amplitude to stabilize, then press ENTER to accept the baseline N1 rpm measuring point. The analyzer will then display the next measuring point: baseline N1 plus 200 rpm. Move the power lever to attain this N1 value, allow 10 to 15 seconds for the phase and amplitude to stabilize, then press ENTER. Repeat the procedure for the following three N1 rpm measuring points:

Baseline N1 plus 400 rpm

Baseline N1 plus 600 rpm

Baseline N1 plus 800 rpm

NOTE: 1. If analyzer indicates NO TACH, shut engine down and check alignment of tachometer and reflective tape or check all cable connections.

NOTE: 2. At each speed, make sure that the engine rpm agrees with the speed requested by the analyzer and that the phase measurement indicated is fairly stable. If the engine speed changes by ± 50 rpm, press the CLR key and start a new average.

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(15) Following the fourth measuring point, the analyzer will display the command ”RETARD ENGINE TO IDLE AND SHUT DOWN“. Return the engine to ground idle speed and shut down engine (Ref. Para. 19., Engine Ground Checks).

(16) Select ENTER on the analyzer keypad, then allow an interval for the ACES analyzer to process the input.

(17) The analyzer will prompt: ”Continue to Balance?“. Select YES using RIGHT ARROW key.

(18) The predicted trial counterweight solution’s mass in grams and angular location in degrees, will be displayed by the analyzer, as well as the prompt ”ATTACH TRIAL WEIGHTS“. Select ENTER to continue or DIAGNOSTIC to abandon survey.

G. Trial Counterweight Fan Trim Balance Run: ACES Model 1700

(1) Install the predicted trial weight solution identified by analyzer as follows:

(a) Remove LP compressor inlet cone (Ref. 72-30-03, MAINTENANCE PRACTICES).

(b) Install class of counterweight closest to trial solution defined by analyzer at indicated fan balance location.

NOTE: Do not install a trial counterweight heavier than required.

(c) After the trial counterweight has been installed, press ENTER on analyzer keypad to continue.

(2) At the FAN INSTALLED WEIGHTS menu, use the arrow keys to enter the hole locations occupied by counterweights. Move cursor to ’MOVE CURSOR HERE WHEN DONE’ field. Press ENTER.

NOTE: The ACES analyzer will suggest up to three available holes: eliminate unwanted solution holes and weight values using the LEFT and RIGHT ARROW keys to find and set NIL (0.00) value.

(3) The analyzer will display SOLUTION WAS and SOLUTION IS panel and will prompt RE-ENTER WEIGHTS? If an incorrect weight or position was entered, select YES using the RIGHT ARROW or DOWN ARROW keys and press ENTER. If the correct weight and position was entered select NO and press ENTER and the analyzer will display prompt to start engine. If YES is selected, the analyzer will return to display at step (2).

(4) Install the inlet cone (Ref. 72-30-03, MAINTENANCE PRACTICES).

(5) Perform engine start procedures (Ref. Para. 19., Engine Ground Checks). Allow engine to stabilize and ground idle speed and engine oil temperature to reach a minimum of 125°F.

(6) Press ENTER key on analyzer.

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(7) Set engine speed to N1 rpm corresponding to previously recorded peak vibration level minus 800 rpm and capture engine vibration levels at four N1 rpm measuring points with predicted trial counterweight solution (Ref. Subpara. F., steps (13) and (14)

(8) Following the fourth measuring point, the analyzer will display the command "RETARD ENGINE TO IDLE AND SHUT DOWN". Return the engine to ground idle speed and shut down engine (Ref. Para. 19., Engine Ground Checks). Press analyzer ENTER key.

(9) The analyzer will prompt the operator to remove the trial trim balance weights installed.

(10) The analyzer will display the vibration summary panel with actual engine vibration levels measured for the predicted trial counterweight solution during four-point reference and trial weight ground runs. The analyzer will also display the prompt "CONTINUE TO BALANCE?". Select YES to procede, the press ENTER; the analyzer will again prompt the operator to remove the trial trim balance weights installed. Select NO to exit.

(11) The analyzer will display the final trim balance counterweight solution. Press ENTER to procede or select DIAG. to exit.

NOTE: The analyzer calculates final or successive solutions based on previous trial trim weight having been removed.

(12) Remove the LP compressor inlet cone and remove the predicted trial weight solution identified by analyzer (Ref. 72-30-03 MAINTENANCE PRACTICES).

(13) Install (final) counterweight solution on fan forward balance rim, then install inlet cone (Ref. 72-30-03 MAINTENANCE PRACTICES).

(14) Proceed to Subpara. H..

H. Final Trim Counterweight Fan Balance Run: ACES Model 1700

(1) Perform engine start procedures (Ref. Para. 19., Engine Ground Checks). Allow engine to stabilize and ground idle speed and engine oil temperature to reach a minimum of 125°F.

(2) Select ENTER key on analyzer keypad.

(3) Set engine speed to N1 rpm corresponding to previously recorded peak vibration level minus 800 rpm and capture engine vibration levels at four N1 rpm measuring points with final counterweight solution (Ref. Subpara. F., steps (13) and (14)

(4) Following the fourth measuring point, the analyzer will display the command "RETARD ENGINE TO IDLE AND SHUT DOWN". Return the engine to ground idle speed and shut down engine (Ref. Para. 19., Engine Ground Checks). Press analyzer ENTER key.

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(5) The analyzer will display the VIBRATION SUMMARY panel with measured reference run and fan trim balance run engine vibration levels and will prompt CONTINUE TO BALANCE?

NOTE: If the counterweight mass/location solutions do not result in a significant reduction of excessive engine vibration following an engine vibration survey/trim balance operation or if the cabin acoustic signature is not improved, it is possible that the LP turbine rotor assembly (Ref. 72-50-03) is out of balance.

(a) If measured engine vibration level is optimised, end balance procedure and record trim weight mass and position, with respect to fan hub V-mark, in engine log book (Ref. 72-30-03, MAINTENANCE PRACTICES for coding procedure for weights).

(b) If engine vibration levels are to be optimised further, select YES at the ”CONTINUE TO BALANCE PROMPT?“, then repeat fan balancing procedure.

(6) Remove all test equipment (Ref. Subpara. J.).

I. Review Trim Balance Results

(1) At main menu, select BALANCE FAN.

(2) At the BALANCE FAN menu, select REVIEW BALANCE JOB.

(3) At REVIEW BALANCE JOB menu select REVIEW BALANCE.

(4) Review applicable engine model, date and job using the RIGHT ARROW or DOWN ARROW keys.

(5) Record the number of runs, vibration level and phase.

(6) Record the class and position of the trim balance counterweights.

J. Removal of Test Equipment

(1) Reinstall compressor inlet cone (Ref. 72-30-03, MAINTENANCE PRACTICES).

(2) Remove reflective tape and test equipment.

(3) Install engine wiring harness N2 connector on exposed N2 speed sensor (Ref. 73-20-04).

(4) Remove residue from reflective tape (PWC05-238) from inlet cone using cleaner (PWC11-042).

(5) Remove residue from reflective tape (PWC05-238) from inlet cone using cleaner (PWC11-042).

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22. Use of Chadwick-Helmuth Model 8500 Equipment

A. On Aircraft Engine Vibration Analysis and Trim Balance - Chadwick-Helmuth Model 8500

(1) Preparation

(a) Remove upper engine cowling (Ref. Airframe Maintenance Manual).

(b) Remove T1 thermocouple probe from aircraft intake duct (Ref. Airframe Maintenance Manual). Secure T1 probe.

(c) Install photoprobe and bracket on intake duct with T1 probe bolts.

(d) Remove three self-locking nuts from 12 o'clock position at flange A.

(e) Install velocimeter and bracket at flange A. Secure bracket to flange with self-locking nuts removed at step (d). Tighten and torque nuts 75 to 85 lb.in.

NOTE: Ensure connector on velocimeter is pointed up.

(f) Locate V-mark on inlet cone rim. For reference, the No.1 fan blade is at or counterclockwise to the V-mark. Mark an index line across fan hub and inlet cone using a marking pencil (PWC05-103) (Ref. Fig. 519).

NOTE: This index line is required at reassembly.

(g) Remove inlet cone assembly (Ref. 72-30-03, Maintenance Practices).

(h) Using metal marking pencil(PWC05-018), draw a line 1.5 inches long from the V-mark on the inlet cone towards the center of the inlet cone.

(i) Clean inlet cone by pencil line with petroleum solvent (PWC11-027) and apply reflective tape (PWC05-238) (Ref. Fig. 519).

(j) Cover two bleed air holes on fan shaft with tape (PWC05-070). Trim tape to end of shaft.

(k) Install inlet cone assembly (Ref. 72-30-03, Maintenance Practices).

(l) Make sure photocell processor light beam projects on center of reflective tape. Tighten photocell processor to prevent movement during balancing operation.

(m) Connect photoprobe and velocimeter cables (Ref. Chadwick-Helmuth).

(n) Perform a normal engine start.

NOTE: Ensure aircraft is pointed into the wind.

(o) Compute take-off power setting using temperature chart.

(2) Vibration Analysis and Trim Balance Procedures

(a) Ensure balancer analyzer has completed "SELF TEST" before continuing.

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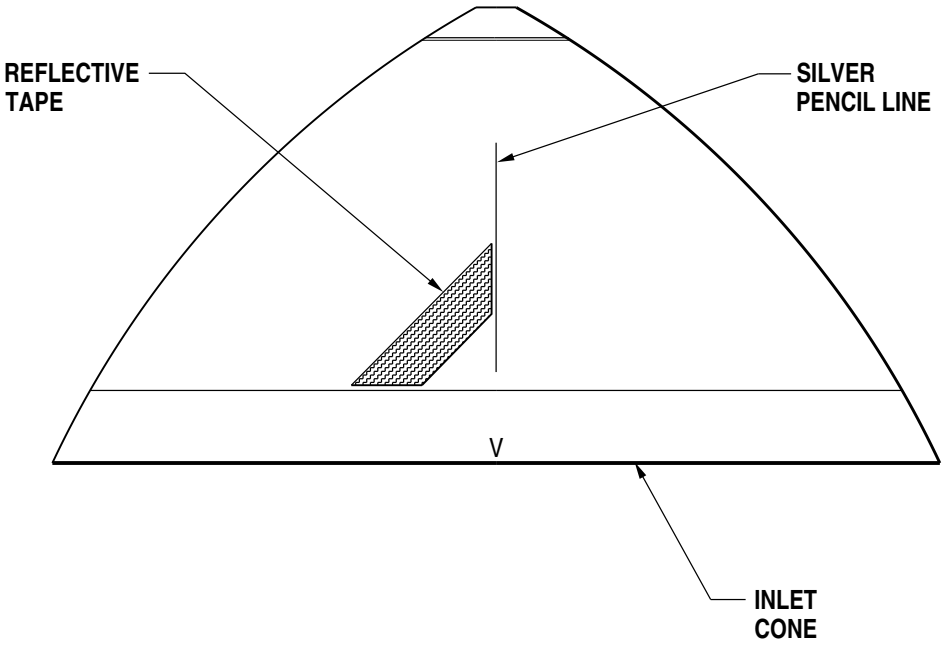

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Installation of Trim Balance Reflective Tape - Inlet Cone
Figure 519

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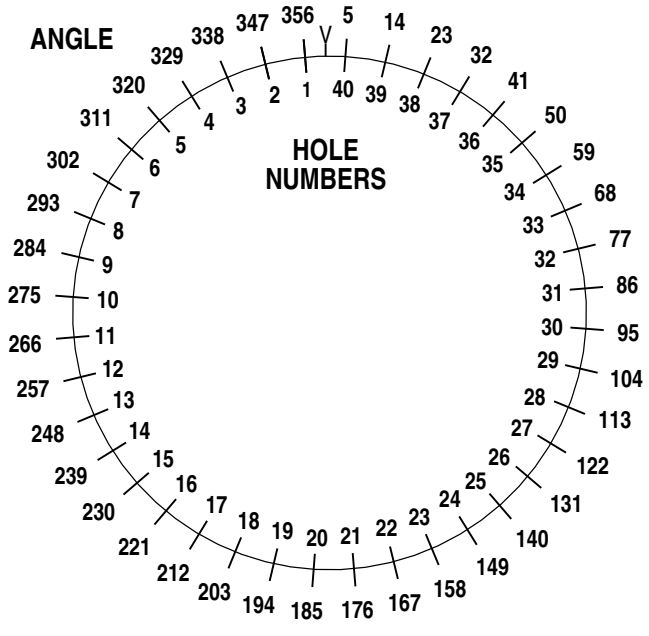

ENGINE S/N

AIRCRAFT S/N L/H R/H

REFERENCE WEIGHT INCLUDING RIVET CHANGE	
CLASS	WEIGHT IN GRAMS
1	2 12
2	3 27
3	4 42
4	9 01
5	13 60

REFERENCE RUN		
N1 RPM	IPS	DEGREES
T/O POWER		
T/O – 200		
T/O – 400		
T/O – 600		
AVERAGE		

TRIM BALANCE WEIGHTS ADDED

CLASS HOLE NO.

CLASS HOLE NO.

CLASS HOLE NO.

REFERENCE RUN		
N1 RPM	IPS	DEGREES
T/O POWER		
T/O – 200		
T/O – 400		
T/O – 600		
AVERAGE		

BALANCED BY

DATE

C24995

Engine Trim Balance - Data Sheet
Figure 520

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(b) Perform engine shutdown on right-hand engine, press SPECTRUM button on analyzer. Press SETUP, enter 50000 for rpm range, select MULTIPLE then press START.

(c) The spectrum display will appear with various peaks at various places along the spectrum line. If the spectrum line appears to be flat, check selector switch on signal selector or switch box is in No.1 position and all connections are correct.

(d) When SPECTRUM display appears with the word MULTIPLE at the upper right hand corner, the display is live and will remain so until the STOP button is pressed.

(e) Ensure aircraft parking brake is firmly set.

(f) Slowly accelerate engine to take-off power (Ref. step (1)(o)). When take-off power is obtained and N1 rpm stabilizes, confirm SPECTRUM display is active.

(g) Note the size of vibration spike at about 15200 rpm. This spike indicates fan vibration. If fan spike is less than 0.15 inch per second (IPS), press STOP button when observing peak is at a minimum, then press PRINT.

(h) Press BALANCE button and follow screen instructions. Take the four readings as instructed by balancing analyzer. If the AVERAGE vibration level of the fan is less than 0.15 IPS, the test is complete: proceed to step (l).

(i) If the average vibration level is 0.15 IPS or greater, press NORM MOV button located under screen ONE TIME ONLY. Print result.

(j) When printing is completed, perform normal engine shutdown of left-hand engine.

(k) Remove inlet cone assembly adjust trim balance weights as specified on printout (Ref. 72-30-03, Maintenance Practices). Replace inlet cone assembly (Ref. 72-30-03, Maintenance Practices). Perform a normal start on left-hand engine.

(l) Ensure balancer analyzer has completed SELF TEST, then select SPECTRUM (MULTIPLE) and press START. Repeat steps (e) through (k) and confirm engine trim balance is complete.

(m) Place selector switch on signal selector or switch box in No.2 position. Perform a normal engine start on right-hand engine and repeat steps (a) through (l).

(n) On completion of fan balance procedure, fill out trim balance data sheet for each engine (Ref. Fig. 520).

(o) Remove photoprobe and bracket from inlet and reinstall T1 thermocouple probe (Ref. Airframe Maintenance Manual).

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(p) Remove self-locking nuts, velocimeter bracket and velocimeter from flange A at intermediate case. Install self-locking nuts on studs at flange A, then tighten and torque 75 to 85 lb.in.

(q) Remove inlet cone assembly and remove tape from shaft (Ref. 72-30-03, Maintenance Practices). Reinstall inlet cone assembly.

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POWER PLANT - CLEANING

1. General

   A. The following details procedures for on-wing engine cleaning.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC11-014	Isopropyl Alcohol
PWC15-011	Inhibitor, Engine Rust (External Engine Cold Section)
PWC15-015	Compound, Corrosion Preventative (Water Displacing)

3. Special Tools

   The special tools listed below are used in the following procedures.

Tool No.	Name
PWC52471	Wash Tube

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Cleaning Procedures

   A. General

      (1) Engine cleaning is confined to external washes, compressor desalination washes and turbine washes. An external wash is recommended whenever the engine is contaminated with salt or volcanic dust. Field cleaning consists of internal washing of the high compressor and internal and external washing of the engine bypass duct.

      CAUTION: ENGINE RUNNING WASH MUST NOT BE CARRIED OUT DUE TO RISK OF INGESTING WASH EQUIPMENT INTO ENGINE.

      (2) A compressor wash performed solely to remove salt or pollution deposits is a desalination wash. The addition of cleaning agents is not necessary, and water only, or water/isopropyl alcohol in freezing conditions, should be used (Ref. Table 702). Motoring washes only are effective for desalination. Regular desalination washing is sufficient to keep the low and high compressors clean in most cases.

      (3) To perform a compressor wash, the engine is motored using the starter and wash fluids are sprayed through the fan at a high flow rate (10 gal/min) using a suitable wash rig with a nozzle angled to ensure cleaning fluid enters the engine core.

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(4) To perform a turbine wash, a special wash tube is inserted into a vacant spark igniter port. The engine is motored using the starter, and wash fluid is sprayed into the turbine/combustion area.

(5) Motoring washes are carried out at an N2 of 8% to 25%. The water or water/isopropyl alcohol mixture is pressurized to 60 psi and sprayed into the compressor inlet via the high flow wash rig.

(6) To prevent corrosion, an engine run must be carried out following a compressor desalination wash to remove any remaining wash fluid from the engine (Ref. Para. 11., Post-Wash Procedures). Further engine corrosion inhibition is provided with optional application of corrosion-inhibiting compound internally following a compressor desalination wash (Ref. Para. 12., Inhibition of Engine Corrosion).

B. Recommended Wash Methods and Intervals

(1) Refer to Table 701 for recommended wash type and frequency.

TABLE 701, Wash Schedule Recommendation

Operating Environment	Nature of Wash	Frequency	Method	Remarks
Continuously salt/smog laden (Ref. 72-00-00, ENGINE TURBINE - INSPECTION).	Desalination	Weekly	Motoring	Recommended after last flight of day. Wash frequency may be optimized based on operator's experience.
Occasionally salt/smog laden	Desalination	Weekly	Motoring	Adjust washing frequency to suit engine condition. A single motoring wash for light contamination or multiple motoring washes for heavy contamination is recommended. Multiple motoring washes should be performed to the extent permitted by starter operating limitations. Observe starter cooling period (Ref. Starter Manufacturer's Manual).

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TABLE 701, Wash Schedule Recommendation (Cont'd)

Operating Environment	Nature of Wash	Frequency	Method	Remarks
Continuously salt/smog laden environment	Turbine Wash	Weekly	Motoring	Wash frequency may be optimized based on operator's experience.
Occasionally salt/smog laden environment	Turbine Wash	Weekly	Motoring	Adjust the wash frequency to suit engine condition or frequency may be optimized based on operator's experience.

6. Engine External Wash

A. Engine External Wash (Ref. Table 702)

CAUTION: DO NOT USE GASOLINE OR SIMILAR TOXIC SUBSTANCES FOR EXTERNAL ENGINE CLEANING. DO NOT ATTEMPT TO WASH AN ENGINE THAT IS STILL HOT OR RUNNING. ALLOW ENGINE TO COOL FOR A MINIMUM PERIOD OF 40 MINUTES AFTER SHUTDOWN TO PREVENT PRECIPITATION FROM INADVERTENT USE OF HARD WATER.

(1) Fresh water external washing is recommended when engine is contaminated with salt, volcanic dust or corrosive chemicals such as those found in industrial smog. Demineralized water is not necessary. The engine should never be left in a contaminated condition overnight, or longer.

(2) If water wash is ineffective, a petroleum solvent (varsol)/water emulsion may be used to remove oil and grime. Thoroughly rinse with water to remove all traces of cleaning fluid. Completely dry the engine using clean, dry compressed air.

NOTE: External cleaning is very effective in tracing possible origin of external oil leakage.

7. Engine Preparation

A. Procedure

(1) Pre-SB7611:

(a) Disconnect P3 tube to HMU and flow divider at gas generator drain valve (Ref. 73-10-10). Cap P3 tube and install blank on HMU and flow divider.

(b) Make sure throttle is in "CUT-OFF" position and aircraft bleed system is shut off. Make sure ignition system is in the OFF position.

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(c) Disconnect gas generator fuel drain line (Ref. 72-70-02), install drain hose and place it in empty container to collect residual solution (Ref. Airframe Maintenance Manual).

(2) Post-SB7611:

(a) Make sure throttle is in "CUT-OFF" position and aircraft bleed system is shut off. Make sure ignition system is in the OFF position.

(3) **Pre-SB7280**: Remove the engine AGB breather hose and install a blanking cap on the bypass duct opening (Ref. 72-60-01, ACCESSORY GEARBOX AND DRIVESHAFT - MAINTENANCE PRACTICES).

CAUTION: CAP MUST BE REMOVED FROM THE AGB BREATHER HOSE BEFORE YOU OPERATE THE ENGINE.

(4) **Post-SB7280**: Do not remove the engine AGB breather hose. Install an applicable blanking cap on the aircraft overboard breather line before you do an external engine wash (Ref. AMM).

B. Preparation of Equipment (Ref. Fig. 701)

(1) Set up compressor wash system as shown on Figure 701.

NOTE: Tubing for interconnection of components is to be 5/16 in. ID minimum.

8. Fan Washing

A. Procedure

WARNING: PUT ON CLEAN COTTON GLOVES WHEN WASHING THE FAN BY HAND AND BE CAREFUL THAT LEADING EDGE OF FAN BLADE MAY BE VERY SHARP.

WARNING: BEFORE FAN WASHING, MAKE SURE THAT STARTER SWITCH AND IGNITION SYSTEM ARE IN OFF POSITION AND THROTTLE LEVER ANGLE (TLA) IN CUT-OFF POSITION.

(1) Fan blade washing is best accomplished by hand with a sponge or soft clean cloth. Each blade must be washed individually on both pressure and suction side.

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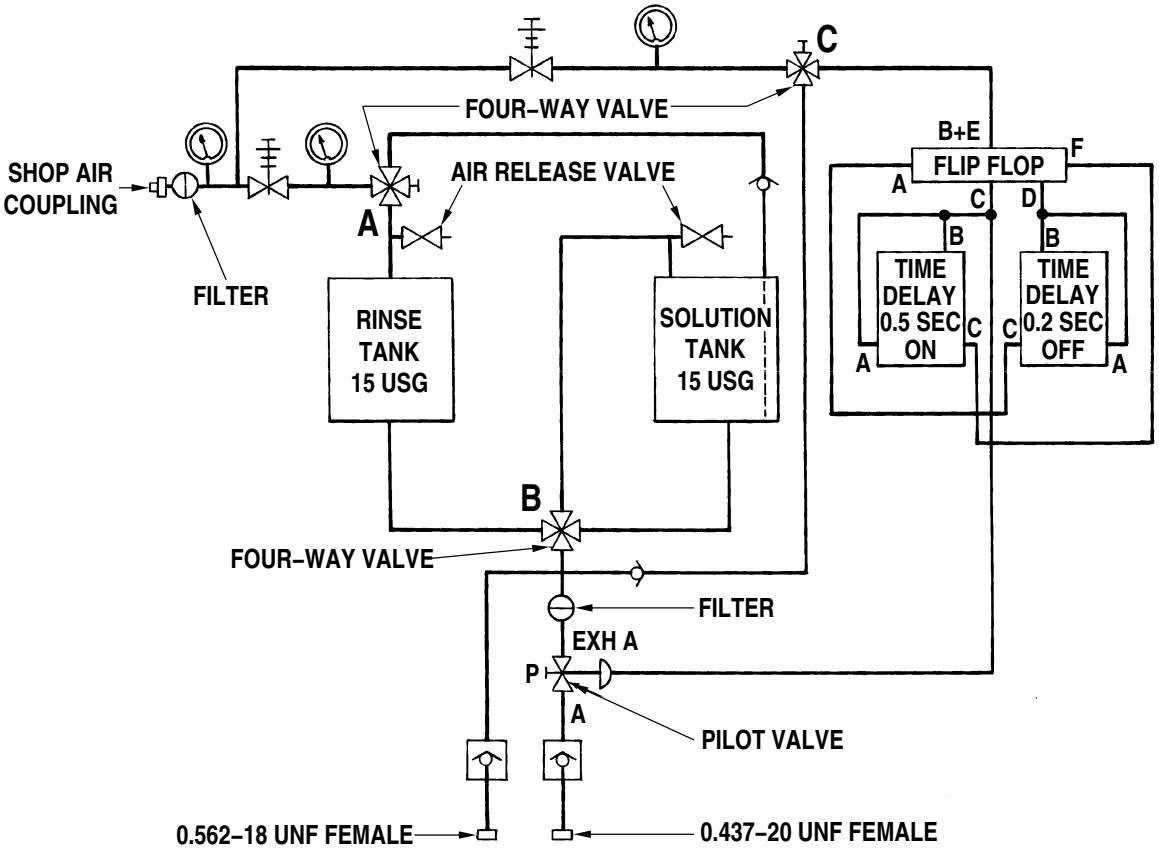

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Compressor Wash System - Schematic
Figure 701

9. Compressor Desalination Wash

A. Compressor Desalination Motoring Wash

CAUTION: DO NOT ATTEMPT TO WASH AN ENGINE THAT IS STILL HOT OR RUNNING. ALLOW ENGINE TO COOL FOR A MINIMUM PERIOD OF 40 MINUTES AFTER SHUTDOWN TO PREVENT PRECIPITATION FROM INADVERTENT USE OF HARD WATER.

CAUTION: MAKE SURE NO ICE FORMS WHEN PERFORMING COMPRESSOR WASH AT TEMPERATURES OF 40°F OR BELOW. USE OF THE CORRECT MIXTURE AS SPECIFIED IN TABLE 702 IS VERY IMPORTANT, ESPECIALLY IF LOW AMBIENT TEMPERATURES ARE EXPECTED BETWEEN THE DESALINATION WASH AND THE NEXT START.

(1) Connect wash rig to wash rig supply. Alternatively, connect wash rig to drinking quality water supply via a suitable hose for ambient temperatures above +2°C (+36°F).

(2) Prepare 5.0 US gallons of rinse solution (Ref. Table 702). Fill wash system rinse tank with prepared rinse solution.

NOTE: If drinking tap water is used for wash rig supply, confirm water pressure is a minimum of 30 psi.

(3) Carry out engine preparation (Ref. Para. 7., preceding).

NOTE: To prevent precipitation of deposits through the use of hard water, engine must be allowed to cool below 65°C (150°F). Minimum cooling period of 40 minutes must be allowed after engine shutdown.

(4) Install wash rig on engine air intake. Ensure nozzles project through fan blades and spray is directed at engine core.

CAUTION: BEFORE MOTORING ENGINE, ENSURE THAT INTAKE DUCT IS CLEAR OF ALL LOOSE OBJECTS AND HOSE ENDS WHICH COULD ENTER ENGINE AND COULD CAUSE ENGINE DAMAGE.

CAUTION: DO NOT MOTOR ENGINE FOR MORE THAN 30 SECONDS. OBSERVE STARTER COOLING PERIOD (REF. STARTER MANUFACTURER'S MANUAL).

(5) Connect and operate wash system ensuring spray is directed at engine core. Accomplish one 30-second dry motoring run while injecting fluid at the rate of 10 gallons per minute.

(6) Allow five minutes for residual fluid to drain from gas generator case, then carry out post-desalination wash procedure (Ref. Para. 11., following).

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TABLE 702, Preparation of Rinse Solution

AMBIENT AIR TEMPERATURE	WATER % by VOL. See NOTE 1	ISOPROPYL ALCOHOL (PWC11-014) % by VOL.
40° F (4.4 °C) And Above	100	0
39 °F (3.9 °C)	95	5
36 °F (2.7 °C)	91	9
33 °F (0.6 °C)	86	14
31 °F (-0.6°C)	83	17
28 °F (-2.2 °C)	80	20
26 °F (-3.3 °C)	78	22
25 °F (-3.9 °C)	77	23
20 °F (-6.7 °C)	73	27
15 °F (-9.4 °C)	68	32
10 °F (-12.2 °C)	64	36
5 °F (-15 °C)	61	39
0 °F (-17.8 °C)	57	43

NOTE: 1. Use of drinking quality water is permitted when performing a rinse following a motoring wash.

10. Turbine Washing

A. Procedure (Ref. Fig. 702)

(1) Carry out procedures in Para. 7., Engine Preparation.

(2) Prepare and fill appropriate wash tank with 10 US gallons of demineralized water (Ref. Para. 7.).

(3) Inspect barrel and spray channel of compressor wash tube (PWC52471) for blockage.

WARNING: RESIDUAL VOLTAGE USED IN IGNITION SYSTEM MAY BE DANGEROUSLY HIGH. MAKE SURE IGNITION IS SWITCHED OFF. ALWAYS DISCONNECT COUPLING NUTS AT IGNITION EXCITER FIRST. ALWAYS USE INSULATED TOOLS TO REMOVE COUPLING NUTS . DO NOT TOUCH OUTPUT CONNECTORS OR COUPLING NUTS WITH BARE HANDS.

(4) Remove a single ignition cable and spark igniter from engine (Ref. 74-20-02).

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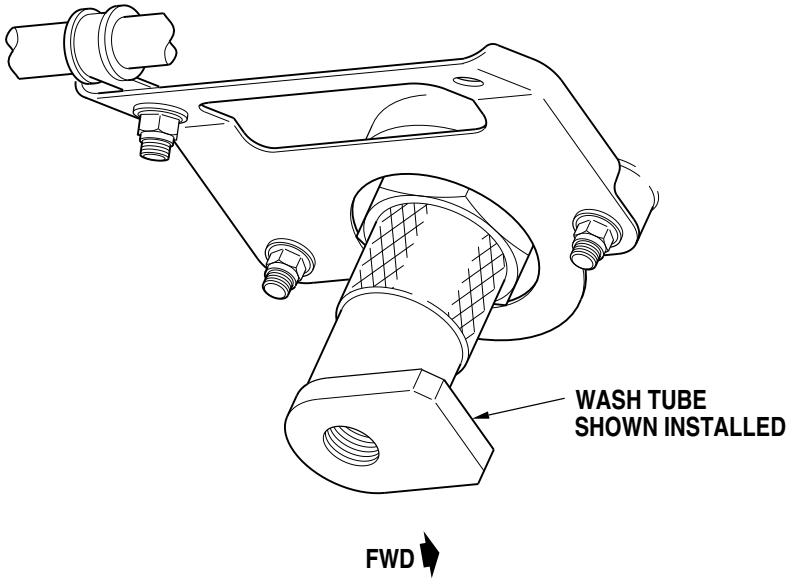

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Installation of Turbine Wash Tube
Figure 702

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CAUTION: HANDLE AND STORE WASH TUBE WITH CARE. INSPECT THREADS BEFORE USE.

(5) Insert barrel of wash tube into engine igniter port and carefully tighten by hand until the arrow at the base of the tube faces forward (pilot's view).

(6) Connect source of pressurized demineralized water to base of wash tube (PWC52471).

CAUTION: DO NOT ATTEMPT TO WASH AN ENGINE THAT IS STILL HOT OR RUNNING. ALLOW ENGINE TO COOL FOR A MINIMUM PERIOD OF 40M MINUTES AFTER SHUTDOWN TO PREVENT PRECIPITATION FROM INADVERTENT USE OF HARD WATER.

CAUTION: BEFORE MOTORING ENGINE, ENSURE THAT INTAKE DUCT IS CLEAR OF ALL LOOSE OBJECTS AND HOSE ENDS WHICH COULD ENTER ENGINE AND CAUSE DAMAGE.

CAUTION: OBSERVE STARTER COOLING PERIOD (REF. STARTER MANUFACTURER'S MANUAL).

(7) When N2 rotation reaches a minimum of 5%, operate wash system and accomplish one 30-second dry motoring run (Ref. ADJUSTMENT/TEST) while injection five gallons of wash fluid at a prescribed rate of 2.66 US gallons per minute.

CAUTION: ALLOW STARTER TO COOL BETWEEN RUNS (REF. STARTER MANUFACTURER'S MANUAL).

(8) Perform one 30-second dry motoring run (Ref. ADJUSTMENT/TEST) to remove rinse water. Allow time for rinse water to drain from engine.

(9) Remove wash tube (PWC52471) and reinstall spark igniter, then install ignition cable (Ref. 74-20-01 and 74-20-02).

(10) Remove drain hose and install gas generator fuel drain line again (Ref. 72-70-02, REAR INNER BYPASS DUCT ASSEMBLY - MAINTENANCE PRACTICES).

(11) Switch ignition ON and ensure audible clicking sound from igniter plug.

(12) Carry out engine start and run for five minutes at GROUND IDLE with CABIN BLEED OFF (Ref. 71-00-00, ADJUSTMENT/TEST, Ground Testing).

(13) Perform engine shutdown ((Ref. 71-00-00, ADJUSTMENT/TEST, Ground Testing).

11. Post-Wash Procedures

A. Procedure

(1) Remove wash system and wash rig (PWC31198).

(2) **Pre-SB7280**: Remove the blanking cap from the bypass duct and install the engine AGB breather hose (Ref. 72-60-01, ACCESSORY GEARBOX AND DRIVESHAFT - MAINTENANCE PRACTICES).

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(3) **Post-SB7280**: Remove the blanking cap from the aircraft overboard breather line (Ref. AMM).

(4) Switch on ignition and ensure audible clicking sound from igniter plug.

(5) Remove blanking caps and reinstall P3 tube between HMU and flow divider (Ref. 73-10-10).

(6) Remove drain hose and reinstall gas generator fuel drain line.

(7) Carry out engine start and run for 5 minutes at GROUND IDLE with CABIN BLEED OFF (Ref. 71-00-00, Adjustment/Test, Ground Testing).

(8) Perform engine shutdown (Ref. Ref. 71-00-00, Adjustment/Test, Ground Testing).

(9) If engine is scheduled to remain inactive for an extended period, allow to cool and install exhaust and inlet covers.

12. Inhibition of Engine Corrosion

CAUTION: REFER TO THE MANUFACTURER'S INSTRUCTIONS FOR DETAILED TECHNICAL PROCEDURES AND THE MATERIAL SAFETY DATA SHEET.

A. Optional On-aircraft Internal Application of Engine Corrosion-inhibiting Solution

WARNING: PERFORM THIS PROCEDURE ONLY AFTER THE ENGINE HAS COOLED COMPLETELY TO AMBIENT TEMPERATURE. MAKE SURE THERE ARE NO SOURCES OF IGNITION PRESENT DURING PREPARATION AND APPLICATION OF THE CORROSION-INHIBITING SOLUTION. IF CORROSION INHIBITORS (PWC15-011) OR (PWC15-015) ARE APPLIED OVER A HOT SURFACE, THE SOLVENT WILL EVAPORATE RAPIDLY AND MAY EASILY IGNITE IF AN IGNITION SOURCE IS PRESENT.

CAUTION: REFER TO THE MANUFACTURER'S INSTRUCTIONS FOR DETAILED TECHNICAL PROCEDURES AND THE MATERIAL SAFETY DATA SHEET.

NOTE: One or more additional desalination washes will help the engine core to cool more quickly.

(1) Perform an engine desalination compressor wash (Ref. Para. 9.).

(2) Refer to the manufacturer's instructions for use of (PWC15-011) or (PWC15-015).

(3) Prepare ½ litre of corrosion-inhibiting solution (PWC15-011) or (PWC15-015) for spray application into the engine inlet.

(4) Do a dry motoring run using aircraft battery power or a ground power unit (Ref. 71-00-00, ADJUSTMENT/TEST - Ground Checks and Aircraft Maintenance and/or Flight Manuals).

(5) When the engine is rotating at the point of maximum attainable engine rpm during the dry motoring run, shut off all electrical circuits.

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CAUTION: DO NOT APPLY CORROSION-INHIBITING SOLUTION ON THE T1 THERMOCOUPLE SENSOR.

(6) As the engine rotational speed decreases, spray the prepared ½ litre of corrosion-inhibiting solution (PWC15-011) or (PWC15-015) onto the inside of the engine inlet case (aft of the T1 thermocouple sensor) and through the fan case boost rotor stator along the gas path to reach the impeller.

(7) Wait for 30 minutes for the solvent in the corrosion-inhibiting solution to evaporate before any further maintenance action.

(8) Complete Para. 11. post-wash procedures.

B. Optional On-aircraft External Application of Engine Corrosion-inhibiting Solution

WARNING: PERFORM THIS PROCEDURE ONLY AFTER THE ENGINE HAS COOLED COMPLETELY TO AMBIENT TEMPERATURE. MAKE SURE THERE ARE NO SOURCES OF IGNITION PRESENT DURING PREPARATION AND APPLICATION OF THE CORROSION-INHIBITING SOLUTION. IF CORROSION INHIBITORS (PWC15-011) OR (PWC15-015) ARE APPLIED OVER A HOT SURFACE, THE SOLVENT WILL EVAPORATE RAPIDLY AND MAY EASILY IGNITE IF AN IGNITION SOURCE IS PRESENT.

CAUTION: REFER TO THE MANUFACTURER'S INSTRUCTIONS FOR DETAILED TECHNICAL PROCEDURES AND THE MATERIAL SAFETY DATA SHEET.

(1) Perform an external engine wash (Ref. Para. 6.).

(2) Check engine external surfaces for corrosion. Remove corrosion on the intermediate case per 70-00-00, REPAIR: Corrosion Treatment.

(3) Apply epoxy enamel paint to repaired areas. Allow to dry.

(4) Prepare a suitable batch of anti-corrosion inhibitor (PWC15-011) or (PWC15-015) for external spray or brush application as required

CAUTION: DO NOT APPLY CORROSION INHIBITORS (PWC15-011) OR (PWC15-015) ON ENGINE ELECTRICAL CONNECTORS, ELECTRONIC COMPONENTS , ON ENGINE CABLES AND PROBES OR ON RUBBER MATERIAL.

CAUTION: DO NOT APPLY CORROSION INHIBITORS (PWC15-011) OR (PWC15-015) AFT OF FLANGE B.

(5) Spray or brush-apply anti-corrosion inhibitor (PWC15-011) or (PWC15-015) onto forward engine external surfaces up to and including the rear flange of the engine intermediate case (Flange B), in accordance with the product manufacturer's instructions.

(6) Wait for 30 minutes for the solvent in the corrosion-inhibiting solution to evaporate before any further maintenance action.

(7) Remove any masking material used.

(8) Complete Para. 11. post-wash procedures.

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LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
LEP	1	Apr 04/2016
	2	Apr 04/2016
	3	Apr 04/2016
	4 blank	Apr 04/2016
Contents	1	Apr 04/2016
	2	Apr 04/2016
	3	Apr 04/2016
	4	Apr 04/2016
	5	Apr 04/2016
	6 blank	Apr 04/2016
72-00-00	1	Nov 10/2014
Description and	2	Nov 10/2014
Operation	3	Nov 10/2014
	4	Nov 10/2014
	5	Nov 10/2014
	6	Nov 10/2014
	7	Nov 10/2014
	8	Nov 10/2014
	9	Nov 10/2014
	10	Nov 10/2014
	11	Nov 10/2014
	12	Nov 10/2014
	13	Nov 10/2014
	14	Nov 10/2014
	15	Nov 10/2014
	16 blank	Nov 10/2014
72-00-00	101	Nov 10/2014
Fault Isolation	102	Nov 10/2014
	103	Nov 10/2014
	104	Nov 10/2014
	105	Nov 10/2014
	106	Nov 10/2014
	107	Nov 10/2014
	108	Nov 10/2014
	109	Nov 10/2014
	110	Nov 10/2014
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	145	Nov 10/2014
	146	Nov 10/2014
	147	Nov 10/2014
	148	Nov 10/2014
	149	Nov 10/2014
	150	Nov 10/2014
	151	Nov 10/2014
	152	Nov 10/2014
	153	Nov 10/2014

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The export control classification with respect to this document is contained on the back of the title page.

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
	154	Nov 10/2014
	155	Nov 10/2014
	156	Nov 10/2014
	157	Nov 10/2014
	158	Nov 10/2014
	159	Nov 10/2014
	160	Nov 10/2014
	161	Nov 10/2014
	162	Nov 10/2014
	163	Nov 10/2014
	164	Nov 10/2014
	165	Nov 10/2014
	166	Nov 10/2014
72-00-00 Servicing	301	Apr 04/2016
	302	Apr 04/2016
	303	Apr 04/2016
	304	Apr 04/2016
	305	Apr 04/2016
	306	Apr 04/2016
	307	Apr 04/2016
	308	Apr 04/2016
	309	Apr 04/2016
	310	Apr 04/2016
	311	Apr 04/2016
	312	Apr 04/2016
	313	Apr 04/2016
	314	Apr 04/2016
	315	Apr 04/2016
	316	Apr 04/2016
	317	Apr 04/2016
	318	Apr 04/2016
	319	Apr 04/2016
	320	Apr 04/2016
	321	Apr 04/2016
	322	Apr 04/2016
	323	Apr 04/2016
	324	Apr 04/2016
	325	Apr 04/2016
	326	Apr 04/2016
72-00-00 Removal/ Installation	401	Oct 06/2006
	402	Oct 06/2006
	403	Oct 06/2006
	404	Oct 06/2006
	405	Oct 06/2006
	406	Oct 06/2006
	407	Oct 06/2006
	408	Oct 06/2006
	409	Oct 06/2006
	410	Oct 06/2006
	411	Oct 06/2006
	412 blank	Oct 06/2006
72-00-00 Inspection Check	601	Apr 04/2016
	602	Apr 04/2016
	603	Apr 04/2016
	604	Apr 04/2016
	605	Apr 04/2016
	606	Apr 04/2016
	607	Apr 04/2016
	608	Apr 04/2016
	609	Apr 04/2016
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	617	Apr 04/2016
	618	Apr 04/2016
	619	Apr 04/2016
	620	Apr 04/2016
	621	Apr 04/2016
	622	Apr 04/2016
	623	Apr 04/2016
	624	Apr 04/2016
	625	Apr 04/2016
	626	Apr 04/2016
	627	Apr 04/2016
	628	Apr 04/2016

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LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
	629	Apr 04/2016
	630	Apr 04/2016
	631	Apr 04/2016
	632	Apr 04/2016
	633	Apr 04/2016
	634	Apr 04/2016
	635	Apr 04/2016
	636	Apr 04/2016
	637	Apr 04/2016
	638	Apr 04/2016
	639 deleted	
	640 deleted	

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The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
ENGINE: TURBINE - DESCRIPTION AND OPERATION	**72-00-00**
1. General	1
2. Engine Data	11
A. Engine Specifications and Leading Particulars	11
B. Engine-Driven Accessories - Leading Particulars	11
C. Fuel and Lubrication System Specifications and Leading Particulars	12
ENGINE: TURBINE - FAULT ISOLATION	**72-00-00**
1. General	101
A. Discovering the Fault	101
B. Isolating Engine Faults	101
C. Mechanical Integrity	101
2. Electronic Fault Diagnosis	101
A. The JEDA Kit Contents	101
B. JEDA Kit Preparation and Storage	102
C. Electronic Fault Diagnosis Procedure	102
D. Operating the Model 560 PDA	102
E. Review Data Display with PDA	104
F. PLA Rigging Checks	105
G. Data Review with Engine Running	106
3. Fault Isolation	107
ENGINE: TURBINE - SERVICING	**72-00-00**
1. General	301
2. Consumable Materials	301
3. Special Tools	301
4. Fixtures, Equipment and Supplier Tools	301

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
ENGINE: TURBINE - SERVICING (Cont'd)	**72-00-00**
5. Servicing the Engine Oil System	302
A. Engine Oil Filter Element	302
B. Engine Lubricating Oil	302
C. Substitution of Engine Lubricating Oil	302
D. Blue Oil Dye	302
E. Oil Analysis	303
F. Oil Level Check	304
G. Draining Oil System	305
H. Filling Oil System	305
I. Flushing Oil System	307
6. Storage and Shipping	308
A. Engine Shipping Container - Description	308
B. Engine Shipping Container - Humidity Control	308
C. Reactivation of Desiccant and Humidity Indicator	308
D. Engine Handling Precautions	309
E. Removal of Engine from Shipping Container	309
F. Installation of Engine into Shipping Container	313
7. Engine Preservation and Depreservation	316
A. Engine Preservation Recommendations	316
B. Engine Preservation Schedule	317
C. Application of Corrosion-Inhibiting Compound to Engine External Areas	319
D. Preservation of Engine Fuel System	319
E. Preservation of Engine Oil System	320
F. Engine Depreservation Schedule	321

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
ENGINE: TURBINE - SERVICING (Cont'd)	**72-00-00**
G. Depreservation of Engine Oil System	322
H. Depreservation of Engine Fuel System	322
I. Regular Operation as an Alternative to the Preservation of Engines	323
8. Removal/Installation of Engine from/into Maintenance Stand	323
A. Installation of Engine in Stand	323
B. Removal of Engine from Stand	325
9. Inhibition of Engine Corrosion	326
A. General	326
B. Recommended Procedures for External and Internal Engine Corrosion Inhibition	326
C. Recommended Procedures for Engine Corrosion Inhibition During Long-term Storage	326
ENGINE: TURBINE - REMOVAL/INSTALLATION	**72-00-00**
1. General	401
2. Consumable Materials	401
3. Special Tools	401
4. Fixtures, Equipment and Supplier Tools	401
5. Removal of Engine from Airframe	401
A. General	401
B. Procedure	401
C. Disposition of Engine Following Removal from Airframe and Installation in Maintenance Stand	402
6. Preparation of Engine Removed from or Installed in Airframe	403
A. General	403
B. Preparation of Front Mount Pads	403
C. Preparation of Rear Engine Mount	403

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
ENGINE: TURBINE - REMOVAL/INSTALLATION (Cont'd)	**72-00-00**
D. Relocation of Oil Filler Neck	406
E. Installation Requirements for Cabin Bleed Air Transfer Tube	407
7. Installation of Engine in Airframe	409
A. Procedure	409
ENGINE: TURBINE - INSPECTION	**72-00-00**
1. General	601
2. Consumable Materials	601
3. Special Tools	601
4. Fixtures, Equipment and Supplier Tools	601
5. Corrosion	601
6. Control Linkage	602
7. Periodic Inspection	602
8. Hot Section Inspection	607
A. Procedure	607
9. Special Conditions Inspection	619
A. Engine Overtemperature	619
B. Foreign Object Damage (FOD)	619
C. Loss of Oil	621
D. Engine Overspeed	622
E. Engine Windmilling	622
F. Engine Immersion in Water	622
G. Engine Dropped During Handling	622
H. Lightning Strike	623
I. Engine Exposed to Fire Extinguishing Agent	623
J. Heavy/Hard Landing	623

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
ENGINE: TURBINE - INSPECTION (Cont'd)	**72-00-00**
K. Aircraft Flown Through a Cloud of Volcanic Ash	624
L. Starter Generator Fail Indication	624
10. Borescope Inspection	625
A. General	625
B. Description	626
C. Basic Use of Borescope	626
D. Removal /Installation of Side Viewing Adapter	626
E. Removal/Installation of Camera	626
F. LP Compressor Boost Stage Rotor and Front Inner Stator	626
G. Impeller	629
H. Fuel Nozzles, Combustion Chamber and Large Exit Duct	629
I. No. 4 Bearing Housing/Overspeed Control Linkage	631
J. HP Turbine Blades	635
K. Fault Isolation	635

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The export control classification with respect to this document is contained on the back of the title page.

ENGINE: TURBINE - DESCRIPTION AND OPERATION

1. General

The JT15D-5 model engine is a lightweight twin spool, front turbofan, jet propulsion engine with a full length annular bypass duct. The low compressor consists of a front compressor (fan) followed by a primary gas path booster stage rotor. A concentric shaft system supports the high and low rotors. The inner shaft supports the fan and booster stage and is driven by a two-stage turbine supported at the rear. The outer shaft supports the high pressure centrifugal compressor and is driven by a single-stage turbine.

Refer to Figures 1, 2 and 3 for the JT15D-5 and Figures 4, 5, and 6 for the JT15D-5R for engine main features and Figures 7, 8 and 9 for cross sections, main flanges, stations, main bearings and shafts.

Air entering the engine through the low compressor case and fan stage is driven rearward through concentric dividing ducts. The air at the inlet of the bypass (outer) duct, passes through a row of fan exit stator vanes and flows rearward to discharge through the annular nozzle. The inner duct features one row of inlet stator vanes immediately behind the fan, and a second row behind the boost rotor. The second row of stator vanes guides primary air to the centrifugal impeller. The high pressure air from the impeller passes through a diffuser assembly which returns flow direction to axial; the air then passes around the combustion chamber liner. Refer to Figure 8.

The combustion chamber liner consists of an annular reverse flow weldment provided with varying sized perforations which allow entry of compressed air. The primary combustion air enters the combustion chamber liner and mixes with fuel. Secondary dilution air enters the liner downstream to lower the temperature and smooth temperature peaks.

Fuel is injected into the combustion chamber by 12 dual orifice type nozzles supplied by a dual manifold. The mixture is ignited by two spark igniters which protrude into the combustion chamber liner. The resultant gases expand from the combustion chamber liner, reverse direction, and pass through the high pressure compressor turbine guide vanes to the high pressure compressor turbine. The turbine guide vanes ensure that the expanding gases impinge on the turbine blades at the proper angle, with maximum velocity and minimum loss of energy. The still expanding gases pass rearward to the two-stage low pressure turbine and associated guide vanes, then to atmosphere through the exhaust duct.

All engine driven accessories, with the exception of the N1 low pressure rotor speed sensor, are mounted on the accessory gearbox secured to the bottom of the intermediate case. The accessories are driven by a tower driveshaft geared to the high pressure rotor shaft (N2), passing vertically downward through the intermediate case to mesh with a bevel gear in the accessory gearbox. The N1 speed sensor is an electromagnetic pulse-type indicator located at the 12 o'clock position on the intermediate case. The probes's proximity to an integral toothed wheel on the LP compressor shaft causes a pulse to be generated as the shaft rotates. The impulse is converted to an electrical signal by the probe then transmitted to the EEC via the engine wiring harness.

The engine oil supply is contained within the intermediate case and is located between the primary and bypass flow passages. The oil tank is sealed at the rear by a separate diaphragm cover. Refer to Table 3 , Fuel and Lubrication Specifications, for oil system data.

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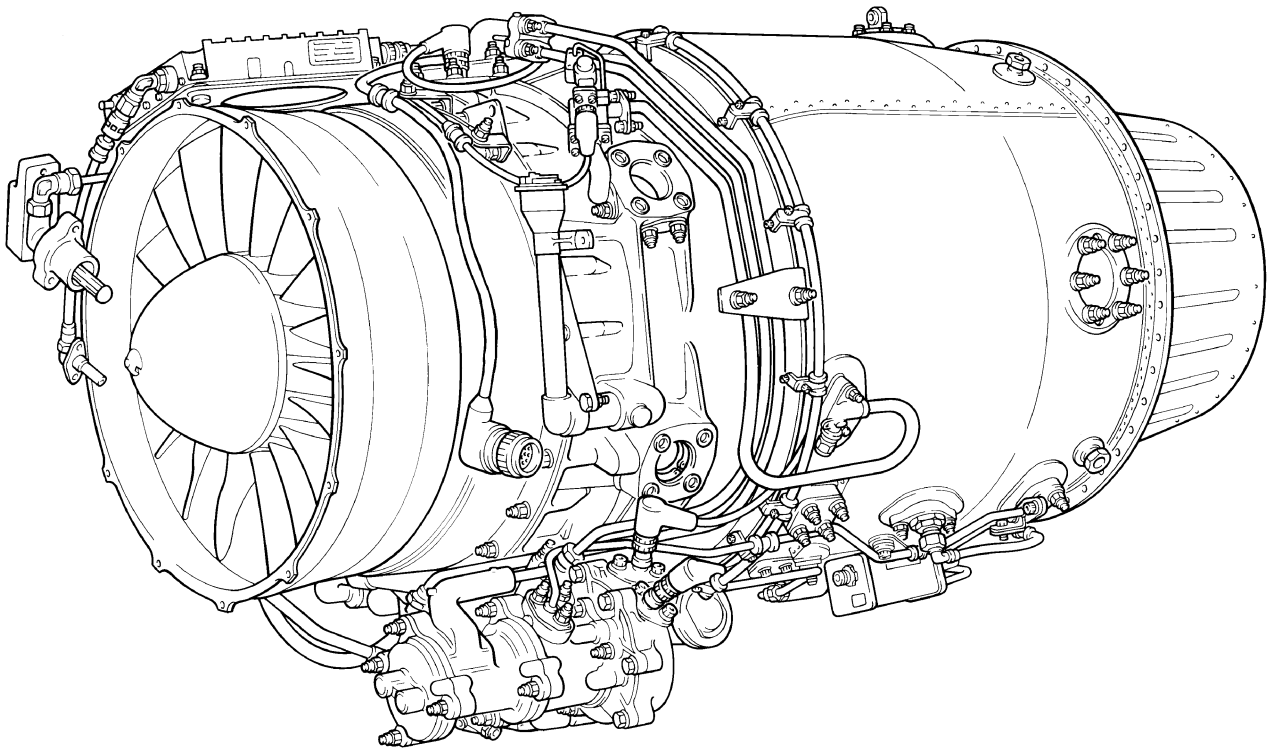

JT15D-5 C11400

Three Quarter View (Left Side)
Figure 1

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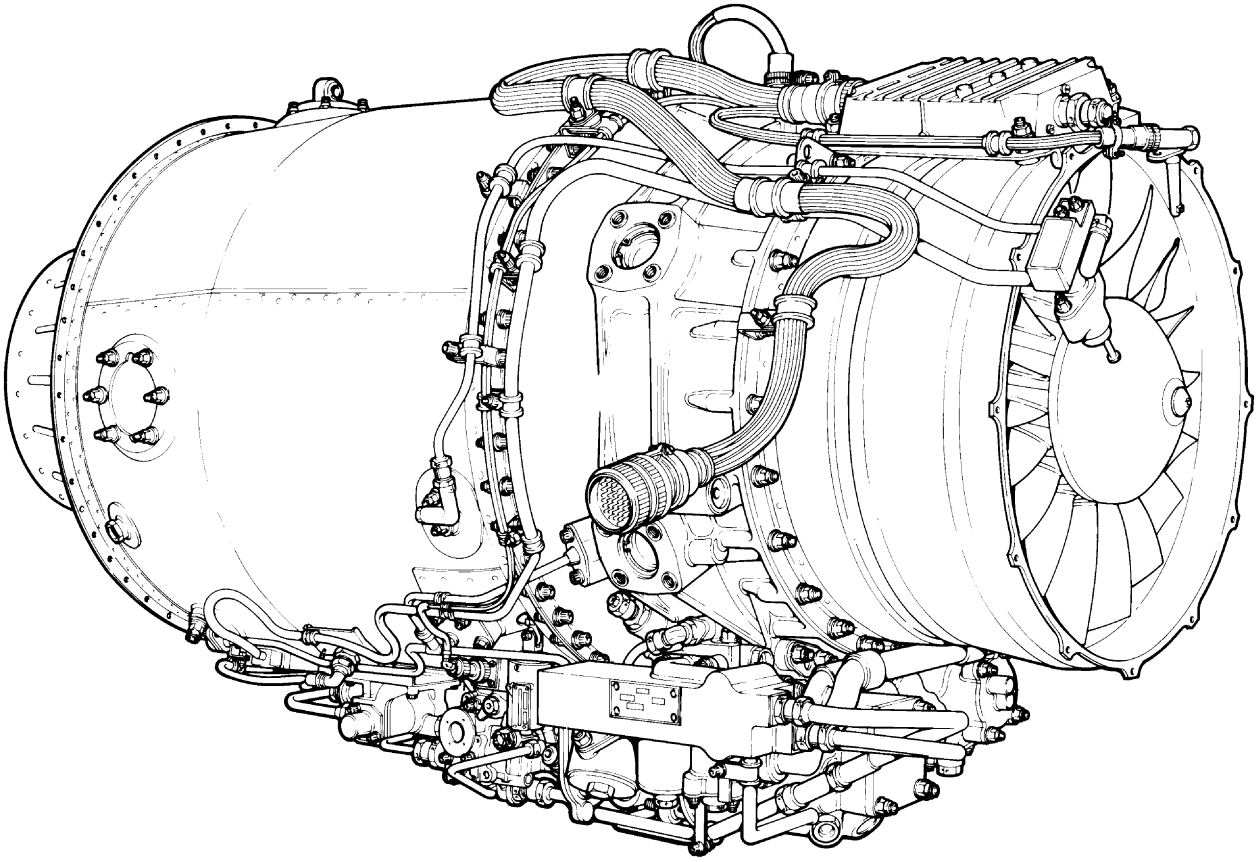

JT15D-5 C11402

Three Quarter View (Right Side)
Figure 2

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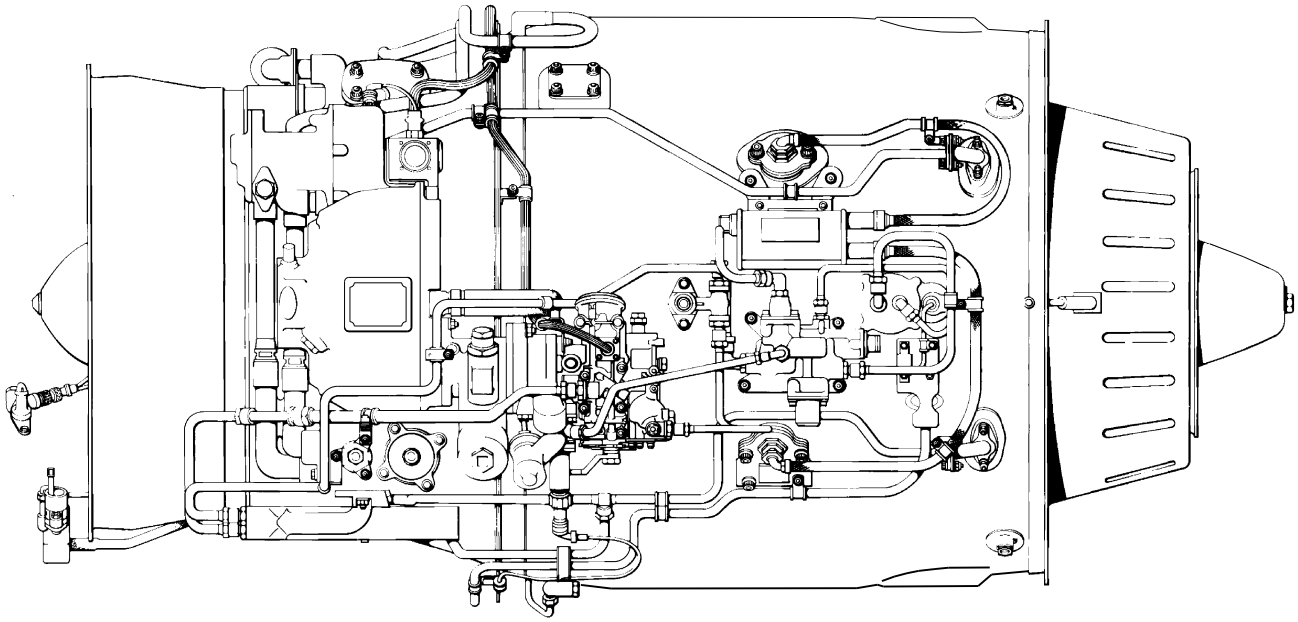

JT15D-5 C11401

Engine - Bottom View
Figure 3

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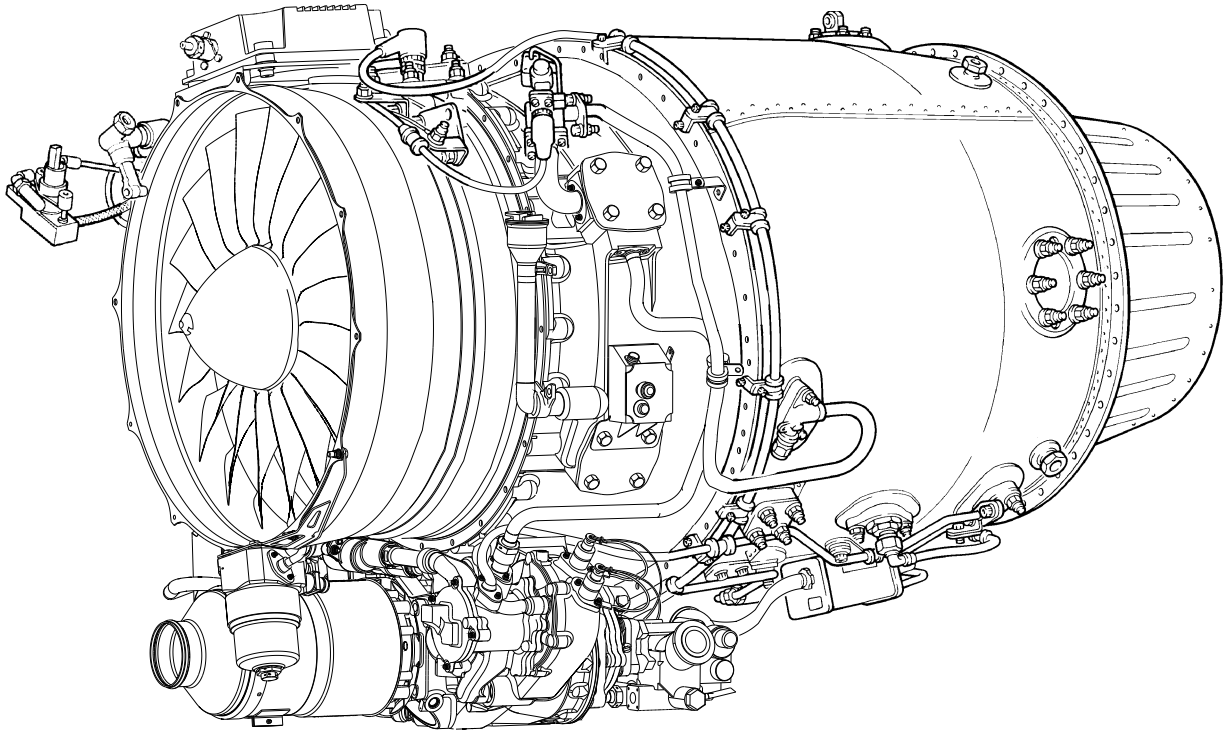

JT15D-5R (Left Engine Installation Shown) C108205

Three Quarter View (Left Side)
Figure 4

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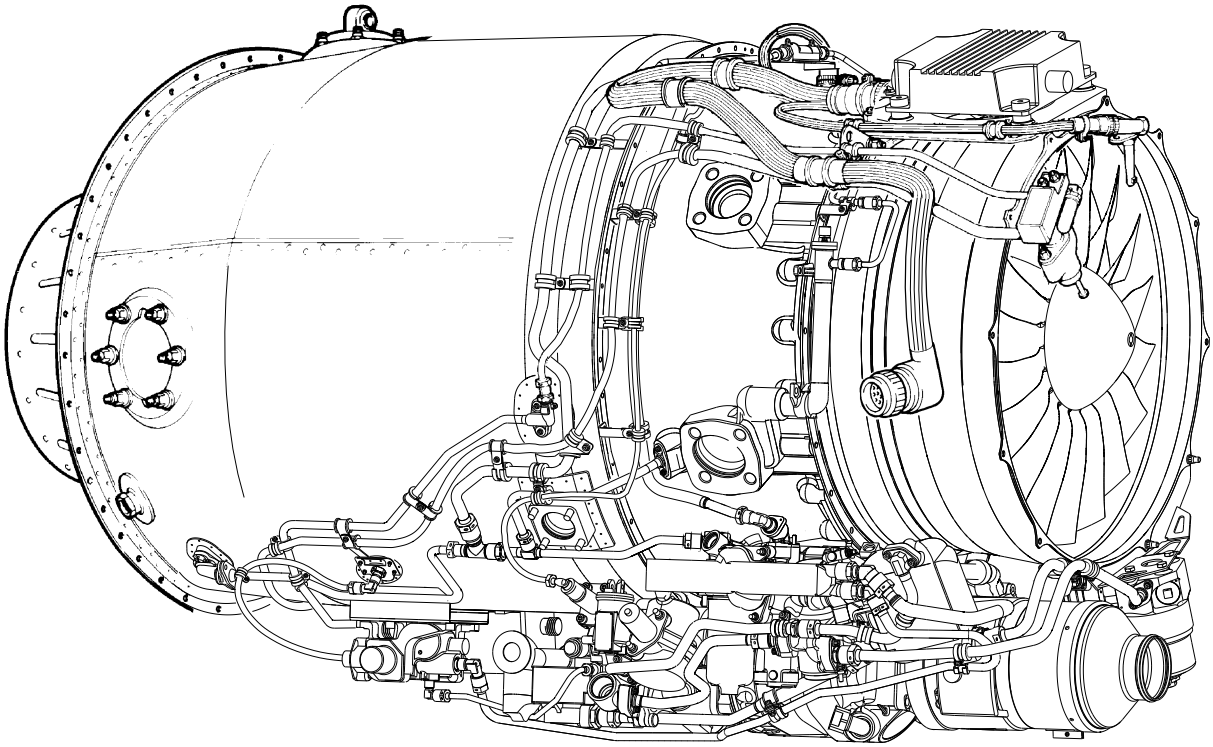

JT15D-5R (Left Engine Installation Shown) C108203A

Three Quarter View (Right Side)
Figure 5

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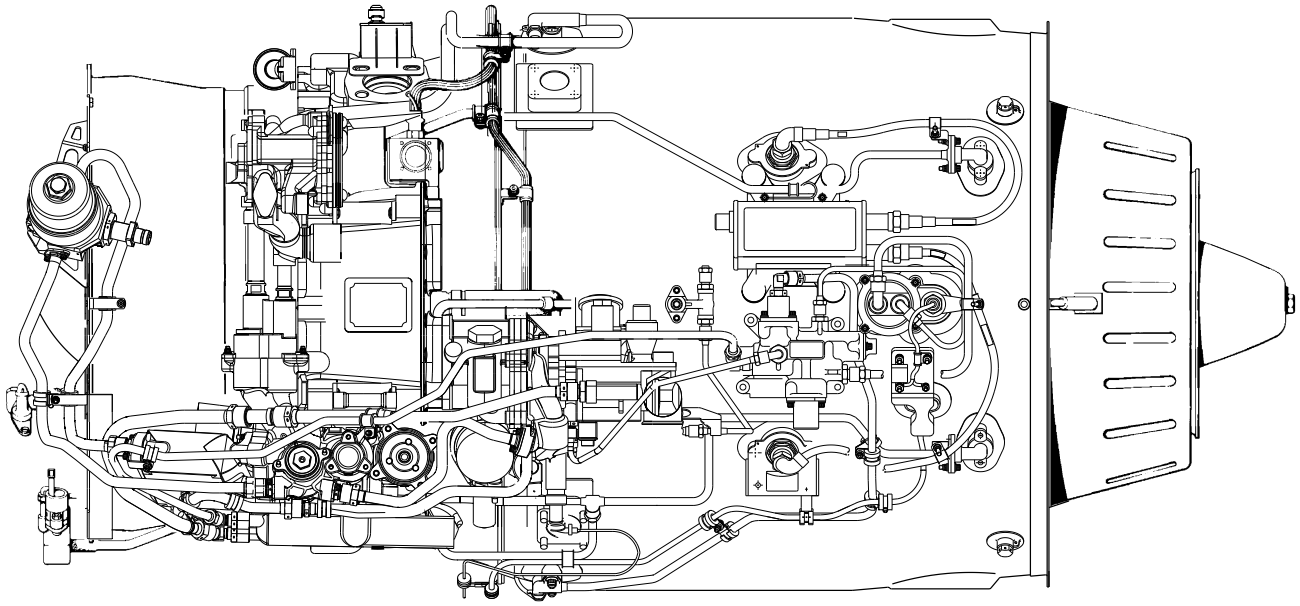

JT15D-5R (Left Engine Installation Shown) C108204

Engine - Bottom View
Figure 6

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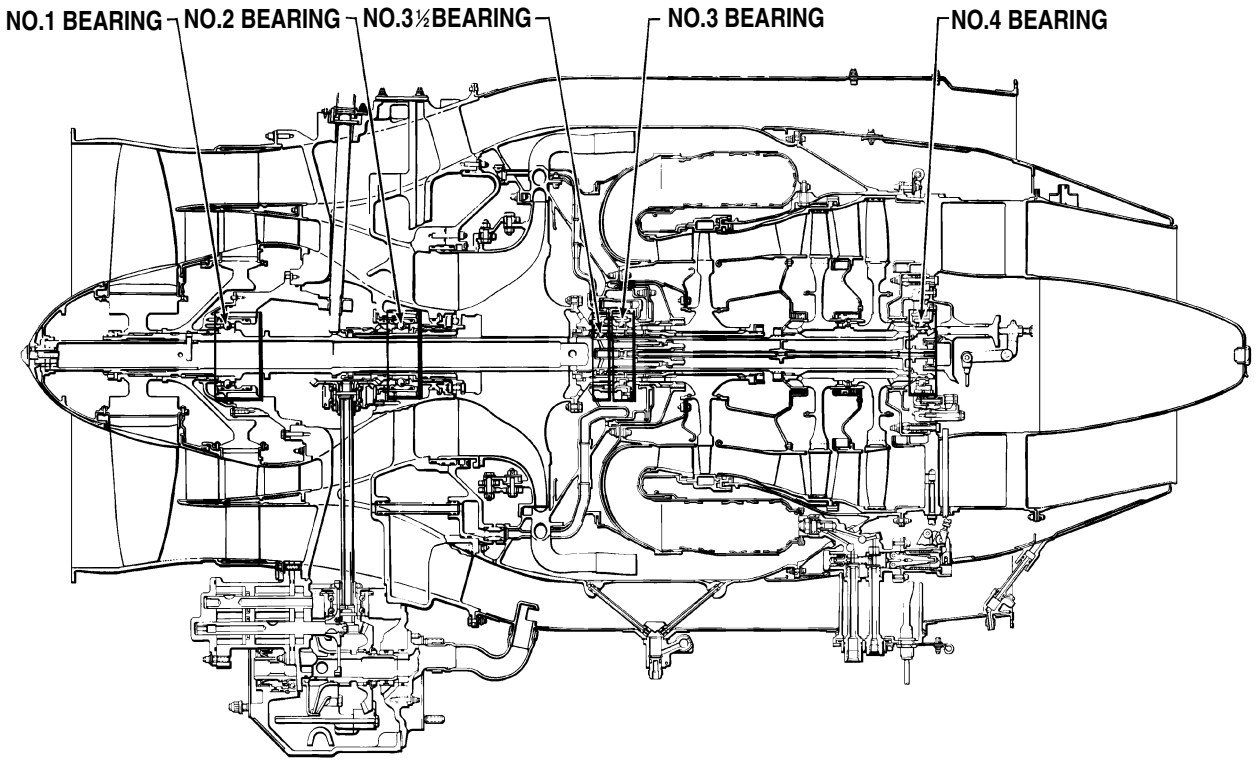

C11443

Engine Cross-section and Bearings
Figure 7

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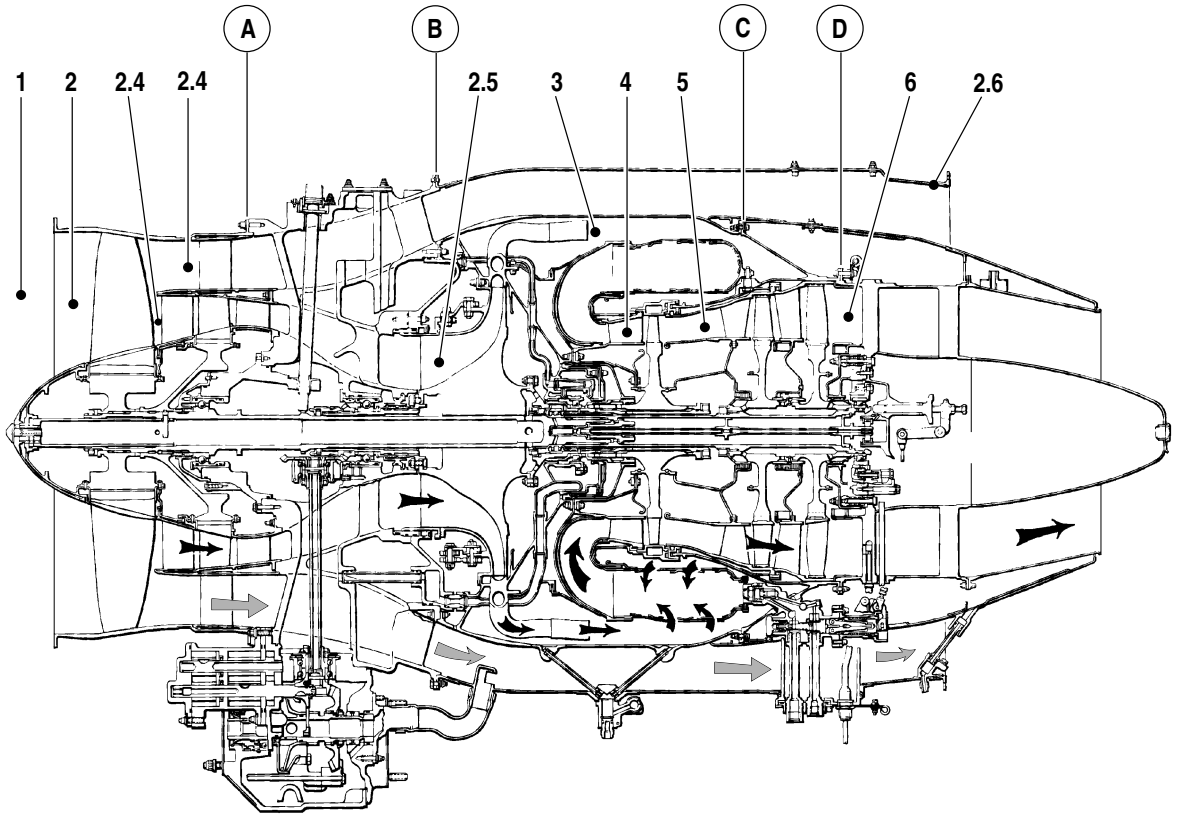

STATIONS

1 AMBIENT
2 ENGINE INLET
2.4 ID LOW COMPRESSOR (INNER DISCHARGE)
2.4 OD LOW COMPRESSOR (OUTER DISCHARGE)
2.5 HIGH COMPRESSOR INLET
2.6 BYPASS DUCT STATIC
3 BURNER INLET
4 HIGH COMPRESSOR TURBINE INLET
5 LOW COMPRESSOR TURBINE INLET
6 EXHAUST DUCT

FLANGES

A LOW COMPRESSOR CASE TO INTERMEDIATE CASE
B INTERMEDIATE CASE TO BY-PASS DUCT
C GAS GENERATOR TO LOW TURBINE STATOR SUPPORT
D LOW TURBINE STATOR SUPPORT TO EXHAUST CASE

PRIMARY AIR FLOW

SECONDARY AIR FLOW (BYPASS AIR)

C11438

Engine Cross-section, Air Flow, Flanges and Stations
Figure 8

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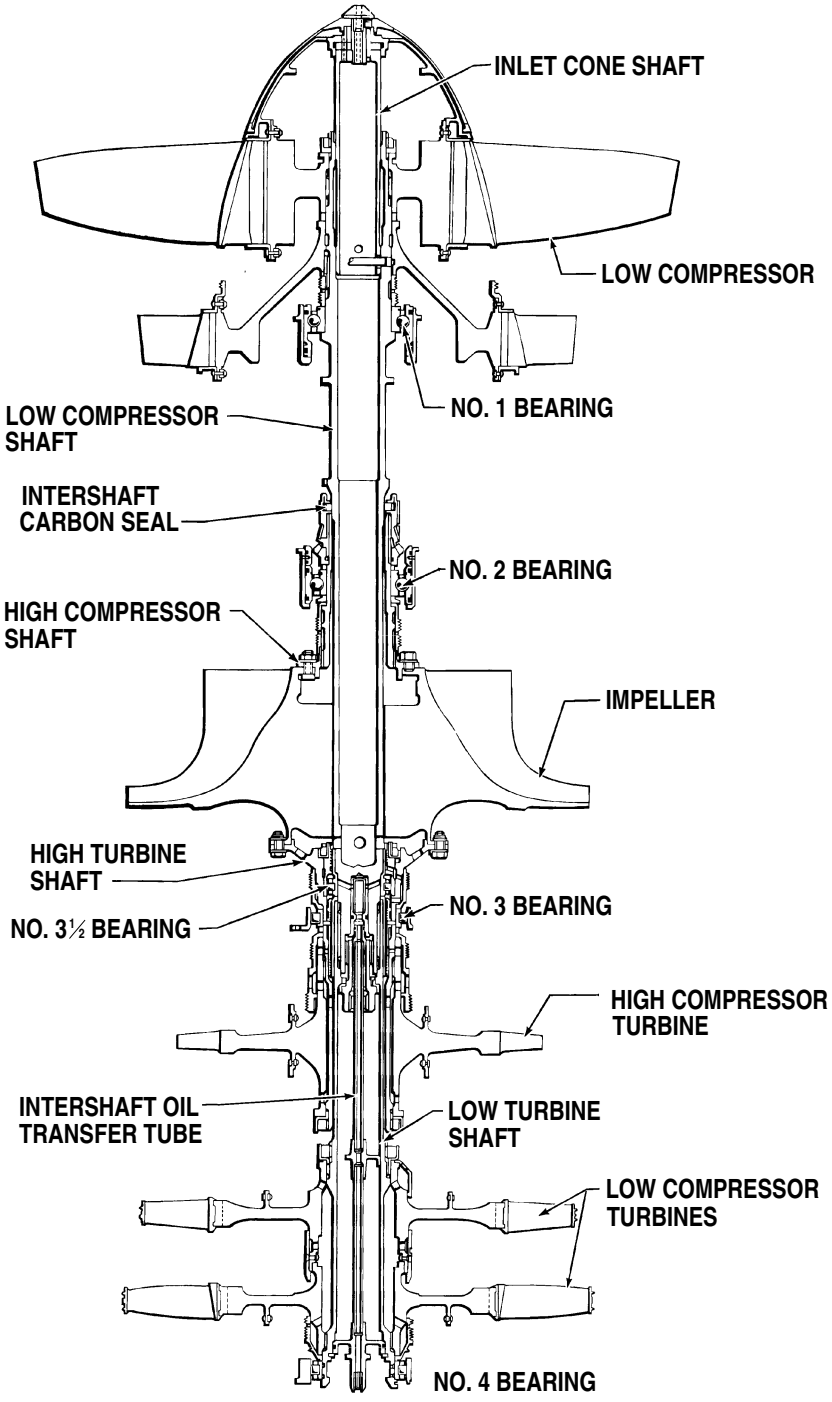

C11441

Main Bearings and Shafts
Figure 9

A compressor bleed valve surrounding the forward part of the high pressure compressor impeller is installed to prevent compressor surge which may occur during engine deceleration at high altitude.

2. Engine Data

A. Engine Specifications and Leading Particulars

Engine specifications and leading particulars are detailed in Table 1.

TABLE 1, Engine Specifications and Leading Particulars

RATING	NET THRUST (LB.)	SPECIFIC FUEL CONSUMPTION lb/hr./lb Thrust (1)
Takeoff	2965 (2)	0.562
Maximum Continuous	2900 (3)	0.562
Maximum Climb	2900	0.562
Maximum Cruise	2414	0.552
Engine Type		Turbofan Jet Propulsion
Type of Combustion Chamber		Annular
Fan Rotation (Looking Forward)		Clockwise
Engine Diameter (Inlet)		21.0 inches
Engine Diameter (Overall)		27 inches (approx.)
Engine Length (Basic at Room Temperature)		63 inches (approx.)
Oil Consumption, Maximum (Over 10 Hours Period)		0.5 lb./hr (227 cc/hr) or 2.3 liters in 10 hours
Maximum Dry Weight		645 lb. (294 Kg) (includes oil cooler)

NOTE: 1. Based on the use of JP4 fuel.

NOTE: 2. Sea Level output, available to 27°C (80°F). No air bleed or airframe accessory power absorption.

NOTE: 3. Sea Level output, available to 15°C (59°F). No air bleed or airframe accessory power absorption.

B. Engine-Driven Accessories - Leading Particulars

Leading particulars for the engine-driven accessories and accessory drives are as follows (Ref. Table 2 and Fig. 10):

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TABLE 2, Engine-driven Accessories

ACCESSORY	ROTATION	RATIO	RPM
Bevel Gear (N2 Input)	CCW	0.844:1	27,663
Breather	-	-	-
Hydraulic Pump (Optional Accessory Drive	CCW	0.1282:1	4,200
Fuel Pump	CCW	0.1282:1	4,200
Oil Pumps and N2 Speed Sensors	CW	0.1282:1	4,200
Starter-Generator	CW	0.3640:1	11,935
N1 Speed Sensor	CW	0.2642:1	4,201

All engine driven accessories, except the LP compressor rotor (N1) speed sensor, are mounted on the accessory gearbox and driven by a tower shaft geared to the high pressure (N2) rotor. The N1 speed sensor is located at the 12 o'clock position on the intermediate case and is actuated by the passing teeth of a machined wheel on the low pressure rotor shaft.

All ratios and rpm values are relative to input speeds from high pressure rotor (N2) and, for the N1 speed sensor, the low pressure rotor as follows:

(a) High pressure rotor - 100 percent N2 : 32,760 rpm

(b) Low pressure rotor - 100 percent N1 : 15, 900 rpm

C. Fuel and Lubrication System Specifications and Leading Particulars

The engine fuel and lubrication system specifications and leading particulars are detailed on Table 3 :

TABLE 3, Fuel and Lubrication Specifications

DESCRIPTION	DATA
Fuel Specification	Refer to SB7144 for Approved Fuels and Additives
Oil Specification	Refer to SB7001
Oil Tank	
Total Capacity	
US Gal.	2.03
Imp. Gal.	1.69
Liter	7.68
Undrainable Oil	
US Gal	0.19
Imp. Gal	0.16
Liter	0.72

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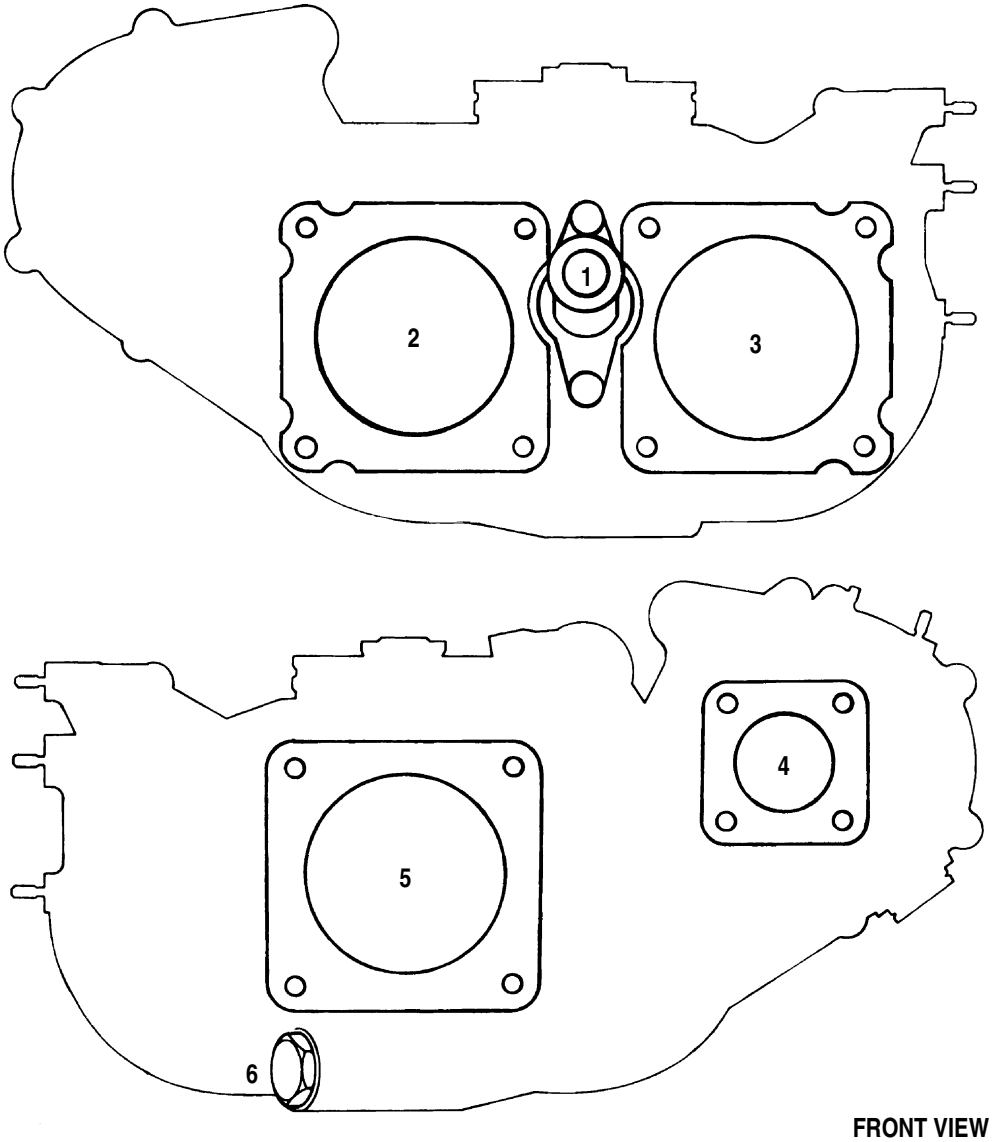

C11390

Gearbox-Accessory Pad Locations and Gear-train
Figure 10 (Sheet 1 of 2)

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Key to Figure 10

1. Breather
2. Optional Accessory
3. Fuel Pump and FCU
4. Oil Pump Assembly and N2 Speed Sensors
5. Starter Generator
6. Gearbox Oil Drain

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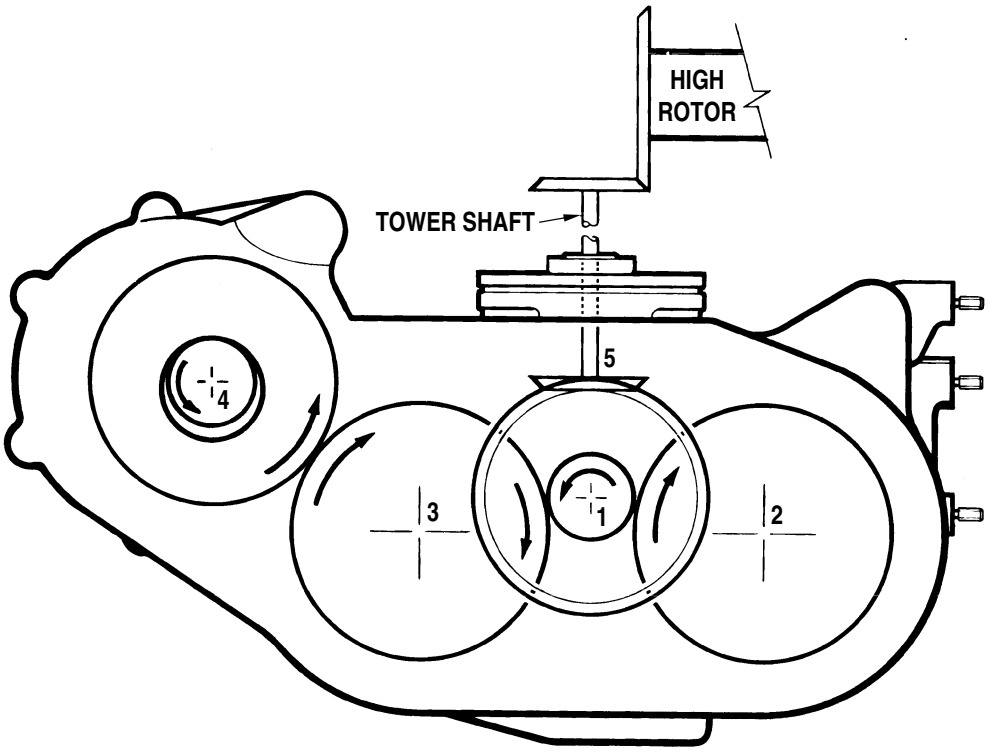

LEGEND

DRIVE	RATIO ACCESSORY SHAFT HIGH ROTOR:	SPEED HIGH ROTOR R.P.M.
INPUT (100% HIGH ROTOR)	1.0000	32760
1. STARTER GENERATOR	0.3640	
2. FUEL PUMP AND H.M.U.	0.1282	
3. HYDRAULIC PUMP	0.1282	
4. OIL PUMPS AND N2 SPEED SENSOR	0.1282	
5. BEVEL GEAR INPUT	0.8444	

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Gearbox-Accessory Pad Locations and Gear-train
Figure 10 (Sheet 2)

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ENGINE: TURBINE - FAULT ISOLATION

1. General

For details on recommended procedures for engine system fault isolation, refer to Tables 101, 102,103 and 104. The tables list figures which comprise checks and procedures to assist an operator in discovering, isolating and correcting problems which may arise with the basic engine or any of its related systems during service.

A. Discovering the Fault

Engine faults can be obvious or hidden. If hidden faults are not detected, serious damage may occur to the engine. It is therefore essential to have a thorough knowledge of correct turbine gas temperature and other important details of engine operation.

Before trying to locate the source of engine trouble or difficulty, or to work on an engine which has been malfunctioning during flight, consult the aircraft flight log and any other available data which could help in diagnosis.

B. Isolating Engine Faults

To correctly isolate a fault, it is necessary to have information about previous faults, if any, and work which has been performed on the engine. Check probable source of engine trouble using relevant diagnostic test sequences, until defect has been isolated. A systematic approach is essential for thorough and efficient troubleshooting and will help extend engine life.

Engine fault isolation can be done with a electronic diagnostic test set to query the engine EEC. The test set can produce messages and fault isolation procedures for a defined set of engine faults. The fault isolation charts listed on Table 105 are the same as those produced by the electronic diagnostic test set. Refer to Para. 2. for engine diagnostic test set instructions.

C. Mechanical Integrity

When troubleshooting any of the following symptoms, take extreme care to ensure the mechanical integrity of engine.

2. Electronic Fault Diagnosis

A. The JEDA Kit Contents

(1) The JEDA kit comes packed in a pelican case and includes the following:

(a) PDA with charging cradle that includes a USB interface for synchronizing with a desktop or a laptop.

(b) Interface cable for the EEC and JEDA test box (Cable has a red overbraid for identification).

(c) JEDA test box.

(d) Activesync program for interfacing the PDA.

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(e) Kit description and instructions.

B. JEDA Kit Preparation and Storage

(1) When first received, the PDA and cradle should be interfaced (synchronized) with a desktop (or laptop) computer that will be used for downloading recordings from the PDA. This requires installation of the Activesync program included in the kit.

(2) Once installed, sync the PDA with the desktop/laptop computer and charge the PDA.

(3) The PDA will discharge completely within a few days of receipt, so it should be charged soon after kit receipt and kept in the charge cradle to be ready for use.

C. Electronic Fault Diagnosis Procedure (Ref Fig. 101)

CAUTION: MAKE SURE POWER IS OFF TO THE ENGINE EEC.

NOTE: This procedure can be performed by one or two qualified personnel.

(1) Remove the engine cowls to get access to the engine EEC (Ref. Aircraft Maintenance Manual).

(2) Disconnect the engine harness P1 connector from the engine EEC (Ref. 73-20-04, ENGINE ELECTRICAL WIRING HARNESS - MAINTENANCE PRACTICES).

(3) Disconnect and remove the P2 trim plug from the engine EEC (Ref. 73-20-03, ENGINE ELECTRONIC CONTROL - MAINTENANCE PRACTICES).

(4) Attach the TEC Model 560 unit on the ECU mounting bracket. The bracket is spring loaded so it can be stretched open and clamped on the mounting bracket.

(5) Connect the red breakout harness 35 pin plug connector to EEC J1 connector.

(6) Connect the red breakout harness 15 pin plug to EEC J2 connector.

(7) Connect the engine harness P1 plug to the 35 pin receptacle connector on the red breakout harness.

(8) Connect the ECU plug connector on the red breakout harness to the TEC Model 560 ECU connection.

(9) Turn power to the engine EEC ON. Refer to Aircraft Maintenance Manual.

D. Operating the Model 560 PDA

CAUTION: PDA SHOULD BE OPERATED IN FIRST ROW BEHIND THE FLIGHT DECK OR OUTSIDE THE AIRCRAFT TO AVOID INTERFERENCES FROM AIRCRAFT'S AVIONICS.

(1) PDA Setup

(a) Select START - Settings - IPAQ Wireless.

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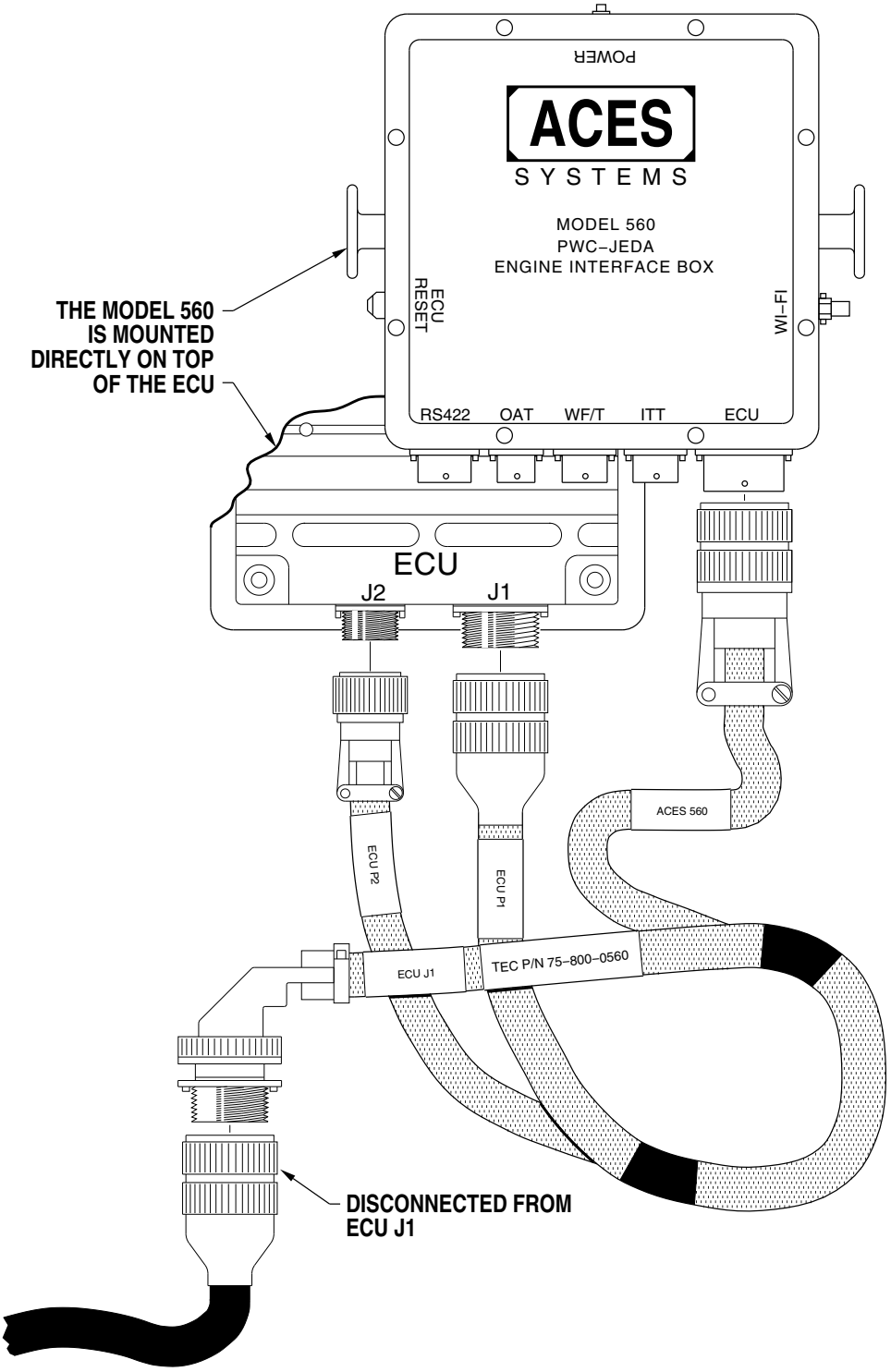

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Setup and Operation of TEC Model 560 PWC-JEDA Diagnostic Kit
Figure 101

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(b) On IPAQ Wireless - Select Settings.

NOTE: If a red "X" is shown in the WiFi circle, press and hold to activate WiFi before selecting settings.

(c) On Settings - Select JEDA 560_xxxx which corresponds to kit serial number.

(d) Select OK to open Mon-EEC.

(e) See MONEEC-PDA screen.

(f) Select JT15D-5 engine model from the 'Engine' drop-down menu.

(g) Select the WiFi-21 from the 'Port' drop-down menu.

(h) Select 'Connect'.

(i) Select appropriate data on Test Information screen. (Enter Data requested on next screen to establish file names for recordings.)

(j) Select 'Continue' to see Fault Display screen.

(k) Select 'Display' to view other screens (i.e. General Display or PLA Display).

E. Review Data Display with PDA

(1) Data Review with Engine not Running:

(a) Faults Monitoring (PO, ADC, NL, EOC, POT.)

(b) Select Faults Display screen.

(c) Check screen for fault indication (Green = normal operation, Yellow = fault).

(d) Taping on fault will bring up troubleshooting chart for the indicated fault.

NOTE: During power up, it's normal to have NH /NH(EOC) to be yellow as the system is still looking for engine RPM. The faults will clear during start. During power up, the fault page will be "grey" until JEDA is connect to the EEC. Red latching fault may be power fault - requires EEC reset.

(e) If all fault messages displayed on the screen are green, there are no engine EEC faults.

(f) If the Latching Reversion fault message displayed on the screen is red, reset EEC via PWR Off and Re-start.

(g) If the Latching Reversion fault message displayed on the screen is still red, there is an engine fault. Check the rest of the fault messages. Engine faults are indicated by a yellow color.

(h) Double-click on the yellow fault message: a troubleshooting chart will appear.

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(i) Turn power to the engine EEC OFF. Refer to the Aircraft Maintenance Manual.

(j) Do the troubleshooting for the indicated fault message. Refer to table 105.

(2) T0 Fault Check

(a) Select General display screen.

(b) Select T0 from drop down boxes.

(c) Verify parameter.

(d) Turn power to the engine EEC OFF. Refer to the Aircraft Maintenance Manual.

(e) Do the troubleshooting as required. Refer to table 105.

F. PLA Rigging Checks

(1) PLA Accuracy

(a) Select PLALO or PLAHI from drop down box.

(b) Tab Idle Box or Take-off Box to verify if angle is in correct range (Green = Good, Red = Out of rig/tolerance).

(c) Cycle PLA forward and back to recheck angles.

(2) PLA Range

(a) Select PLA display screen.

(b) Select PLA TOT from drop down box.

(c) Select time interval (30 or 60 seconds).

(d) Operate the PLA lever from Idle to TO.

(e) Monitor graph display for erratic indication or topping out (flat line near the top of the chart).

(f) Verify parameter.

(g) Turn power to the engine EEC OFF. Refer to the Aircraft Maintenance Manual.

(h) Do the troubleshooting as required. Refer to table 105.

(3) HMU Potentiometer Check (POT check)

(a) Select PLA display screen.

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(b) Select either PLA TOT or PLALO or PLAHI. Select time interval (Recommend 60 seconds for clarity).

NOTE: The PLALO or PLAHI can be used to get the greatest detail, but the range is reduced.

(c) Tap START, advance PLA from Idle to TO.

(d) Monitor the graph for smooth display (spikes are not acceptable, required HMU replacement).

(e) Turn power to the engine EEC OFF. Refer to the Aircraft Maintenance Manual.

(f) Do the troubleshooting as required. Refer to table 105.

G. Data Review with Engine Running

(1) Start the engine (Ref. 71-00-00, POWER PLANT - ADJUSTMENT/TEST).

NOTE: Until the engine speed is greater than a minimum rpm, the EEC will always generate a latching reversion fault for N2 Speed Sensor fault message.

(2) Operate the engine at ground idle speed.

(3) Power up JEDA Box.

(4) Faults Monitoring (PO, ADC, NL, EOC, POT.)

(5) Select Faults Display screen.

(6) Check screen for fault indication (Green = normal operation, Yellow = fault).

(7) Taping on fault will bring up troubleshooting chart for the indicated fault.

NOTE: During power up, it's normal to have NH /NH(EOC) to be yellow as the system is still looking for engine RPM. The faults will clear during start. During power up, the fault page will be "grey" until JEDA is connect to the EEC. Red latching fault may be power fault-requires EEC reset.

(8) If all fault messages displayed on the screen are green, there are no engine EEC faults.

(9) If the Latching Reversion fault message displayed on the screen is red, there is an engine fault. Check the rest of the fault messages, engine faults are indicated by a yellow color.

(10) Double-click on the yellow fault message, a troubleshooting chart will appear.

(11) Turn power to the engine EEC OFF. Refer to the Aircraft Maintenance Manual.

(12) Do the troubleshooting for the indicated fault message. Refer to table 105.

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(13) Parameters Monitoring (OAT, PLA, N1, N2, TO, PO, PLALO, PLAHI, PLATOT, POT.)

(a) Select General Display screen or PLA Dynamic Response.

(b) Select parameters from drop down boxes.

(c) Verify parameter via graph display.

(d) Turn power to the engine EEC OFF. Refer to the Aircraft Maintenance Manual.

(e) Do the troubleshooting as required. Refer to table 105.

(14) Five Points Performance Run (N1, N2, TO, ITT, WF) (Optional)

(a) Select General Display screen.

(b) Verify parameter via graph display.

NOTE: External harnesses are required.

(15) Query the EEC using the TEC Model 560 PDA to make sure the engine fault message no longer appears.

(16) Shut down the engine (Ref. 71-00-00, POWER PLANT - ADJUSTMENT/TEST).

(17) Allow the engine to cool for 30 minutes.

(18) Turn power to the engine EEC OFF. Refer to the Aircraft Maintenance Manual.

(19) Remove the TEC Model 560 components from the engine.

(20) Connect the engine harness P1 connector to the engine EEC (Ref. 73-20-04, ENGINE ELECTRICAL WIRING HARNESS - MAINTENANCE PRACTICES).

(21) Connect the P2 trim plug to the engine EEC (Ref. 73-20-03, ENGINE ELECTRONIC CONTROL - MAINTENANCE PRACTICES).

(22) If the engine EEC was replaced, do the required ground checks (Ref. 71-00-00, POWER PLANT - ADJUSTMENT/TEST).

3. Fault Isolation

To help in isolating faults systematically, engine faults are categorized into four basic classes. These groups are further subdivided into common problems and presented as logic flow charts. These are indexed as follows:

TABLE 101, Fault Isolation for Engine Start Faults

FIGURE TITLE	FIGURE NO.
Hot Start	102
Slow Acceleration to Engine Speed	103

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TABLE 101, Fault Isolation for Engine Start Faults (Cont'd)

FIGURE TITLE	FIGURE NO.
Slow Acceleration to Engine Speed: JT15D-5 (Post-SB7493/Post-SB7526/ Post-SB7598) and JT15D-5R	104
Hung Start: JT15D-5 (Post-SB7493/Post-SB7526/ Post-SB7598) and JT15D-5R Engines	105
No Rotation of Engine	106
Engine Fails to Light Up	107

TABLE 102, Fault Isolation for Engine Operating Problems

FIGURE TITLE	FIGURE NO.
Idle Speed Incorrect	108
Low Fuel Pressure Indication	109
Engine Fails to Accelerate from Idle Speed	110
Engine Fails to Decelerate Properly	111
Engine Temperature Limited	112
Engine Flame Out/Major Roll Back (Auto Deceleration)	113
Unconfirmed EEC Fault	114
Abnormally Low T5	115
Engine Does Not Meet Take-Off Power For The Day	129
Power Lever Splits During Climb And/Or at Altitude	130
Power Lever Splits During Ground Operation or In Flight	131
Vibration	132
Engine Surge	133

TABLE 103, Fault Isolation for Engine Lubrication Problems

FIGURE TITLE	FIGURE NO.
High Oil Temperature	117
Low Oil Pressure	118
Fluctuating Oil Pressure	119
High Oil Pressure	120
Excessive Oil Consumption	121
Oil leaks from AGB Overboard Drains	122

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TABLE 103, Fault Isolation for Engine Lubrication Problems (Cont'd)

FIGURE TITLE	FIGURE NO.
Oil Leak from No.4 Bearing Area or Smoke Out of Tail Pipe	123
Discolored Oil	124
Chip Detector Indication	125
Oil Filter Bypass Indication	126

TABLE 104, Fault Isolation for Miscellaneous Engine Problems

FIGURE TITLE	FIGURE NO.
Fuel Leakage from Pump Drain	127
Squeal Audible at Spool Down or During Motoring Cycle	128
Overtemperature Popup Indicator Activation - JT15D-5R Engines	134

To help in isolating faults with the JEDA equipment, engine faults are indexed as follows:

TABLE 105, Fault Isolation for Electronic Diagnostic Test Set

FIGURE TITLE	FIGURE NO.
Analog/Digital End Of Conversion Fault	135
Analog/Digital Conversion End Of Conversion Fault	136
Engine EEC Fault	137
N2 Speed Sensor Fault	138
HMU Potentiometer Excitation Fault	139
Power Lever Angle (PLA) Fault	140
Power Lever Angle Reversion Non-Latching Fault	141
P0 Sensor Bias Fault	142
P0 Sensor Fault	143
T0 Sensor Fault	144

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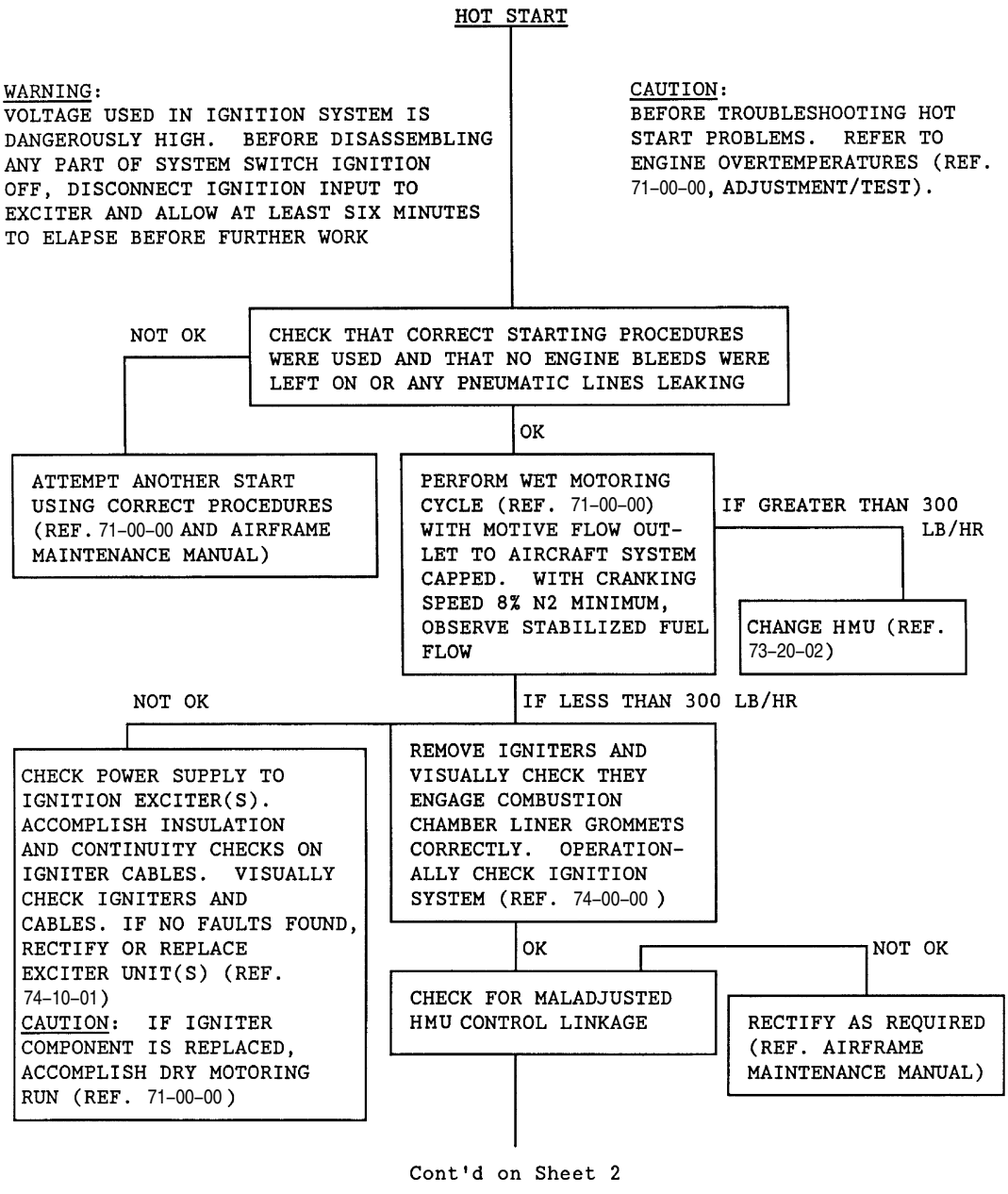
HOT START
WARNING:
VOLTAGE USED IN IGNITION SYSTEM IS DANGEROUSLY HIGH. BEFORE DISASSEMBLING ANY PART OF SYSTEM SWITCH IGNITION OFF, DISCONNECT IGNITION INPUT TO EXCITER AND ALLOW AT LEAST SIX MINUTES TO ELAPSE BEFORE FURTHER WORK
CAUTION:
BEFORE TROUBLESHOOTING HOT START PROBLEMS. REFER TO ENGINE OVERTEMPERATURES (REF. 71-00-00, ADJUSTMENT/TEST).
CHECK THAT CORRECT STARTING PROCEDURES WERE USED AND THAT NO ENGINE BLEEDS WERE LEFT ON OR ANY PNEUMATIC LINES LEAKING
NOT OK
OK
ATTEMPT ANOTHER START USING CORRECT PROCEDURES (REF. 71-00-00 AND AIRFRAME MAINTENANCE MANUAL)
PERFORM WET MOTORING CYCLE (REF. 71-00-00) WITH MOTIVE FLOW OUTLET TO AIRCRAFT SYSTEM CAPPED. WITH CRANKING SPEED 8% N2 MINIMUM, OBSERVE STABILIZED FUEL FLOW
IF GREATER THAN 300 LB/HR
CHANGE HMU (REF. 73-20-02)
NOT OK
IF LESS THAN 300 LB/HR
CHECK POWER SUPPLY TO IGNITION EXCITER(S). ACCOMPLISH INSULATION AND CONTINUITY CHECKS ON IGNITER CABLES. VISUALLY CHECK IGNITERS AND CABLES. IF NO FAULTS FOUND, RECTIFY OR REPLACE EXCITER UNIT(S) (REF. 74-10-01)
CAUTION: IF IGNITER COMPONENT IS REPLACED, ACCOMPLISH DRY MOTORING RUN (REF. 71-00-00)
REMOVE IGNITERS AND VISUALLY CHECK THEY ENGAGE COMBUSTION CHAMBER LINER GROMMETS CORRECTLY. OPERATIONALLY CHECK IGNITION SYSTEM (REF. 74-00-00)
OK
NOT OK
CHECK FOR MALADJUSTED HMU CONTROL LINKAGE
RECTIFY AS REQUIRED (REF. AIRFRAME MAINTENANCE MANUAL)
Cont'd on Sheet 2

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Hot Start
Figure 102 (Sheet 1 of 2)

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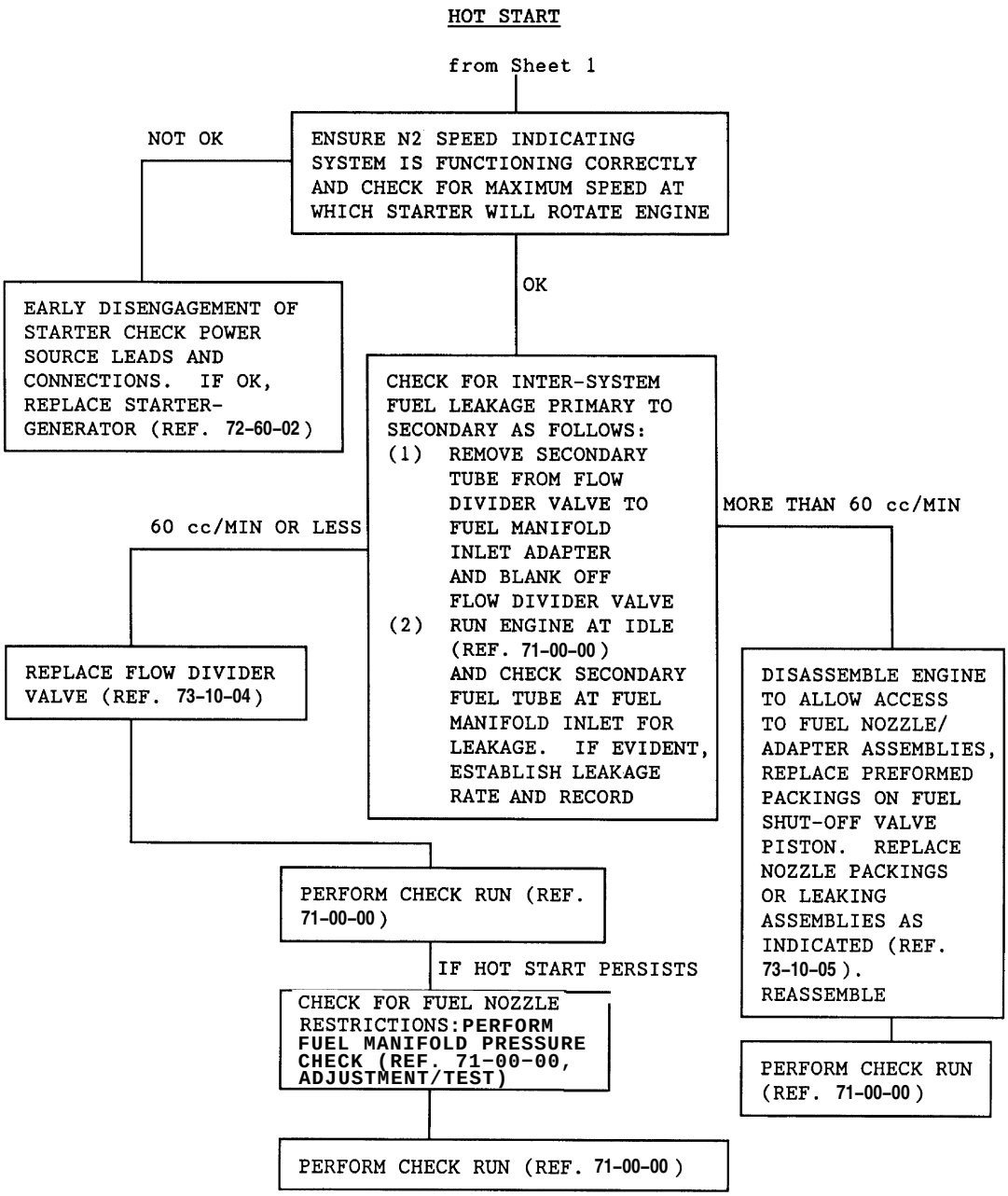
HOT START
from Sheet 1
ENSURE N2 SPEED INDICATING SYSTEM IS FUNCTIONING CORRECTLY AND CHECK FOR MAXIMUM SPEED AT WHICH STARTER WILL ROTATE ENGINE
NOT OK
EARLY DISENGAGEMENT OF STARTER CHECK POWER SOURCE LEADS AND CONNECTIONS. IF OK, REPLACE STARTER-GENERATOR (REF. 72-60-02)
OK
CHECK FOR INTER-SYSTEM FUEL LEAKAGE PRIMARY TO SECONDARY AS FOLLOWS:
(1) REMOVE SECONDARY TUBE FROM FLOW DIVIDER VALVE TO FUEL MANIFOLD INLET ADAPTER AND BLANK OFF FLOW DIVIDER VALVE
(2) RUN ENGINE AT IDLE (REF. 71-00-00) AND CHECK SECONDARY FUEL TUBE AT FUEL MANIFOLD INLET FOR LEAKAGE. IF EVIDENT, ESTABLISH LEAKAGE RATE AND RECORD
60 cc/MIN OR LESS
MORE THAN 60 cc/MIN
REPLACE FLOW DIVIDER VALVE (REF. 73-10-04)
DISASSEMBLE ENGINE TO ALLOW ACCESS TO FUEL NOZZLE/ ADAPTER ASSEMBLIES, REPLACE PREFORMED PACKINGS ON FUEL SHUT-OFF VALVE PISTON. REPLACE NOZZLE PACKINGS OR LEAKING ASSEMBLIES AS INDICATED (REF. 73-10-05). REASSEMBLE
PERFORM CHECK RUN (REF. 71-00-00)
IF HOT START PERSISTS
CHECK FOR FUEL NOZZLE RESTRICTIONS: PERFORM FUEL MANIFOLD PRESSURE CHECK (REF. 71-00-00, ADJUSTMENT/TEST)
PERFORM CHECK RUN (REF. 71-00-00)
PERFORM CHECK RUN (REF. 71-00-00)

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Hot Start
Figure 102 (Sheet 2)

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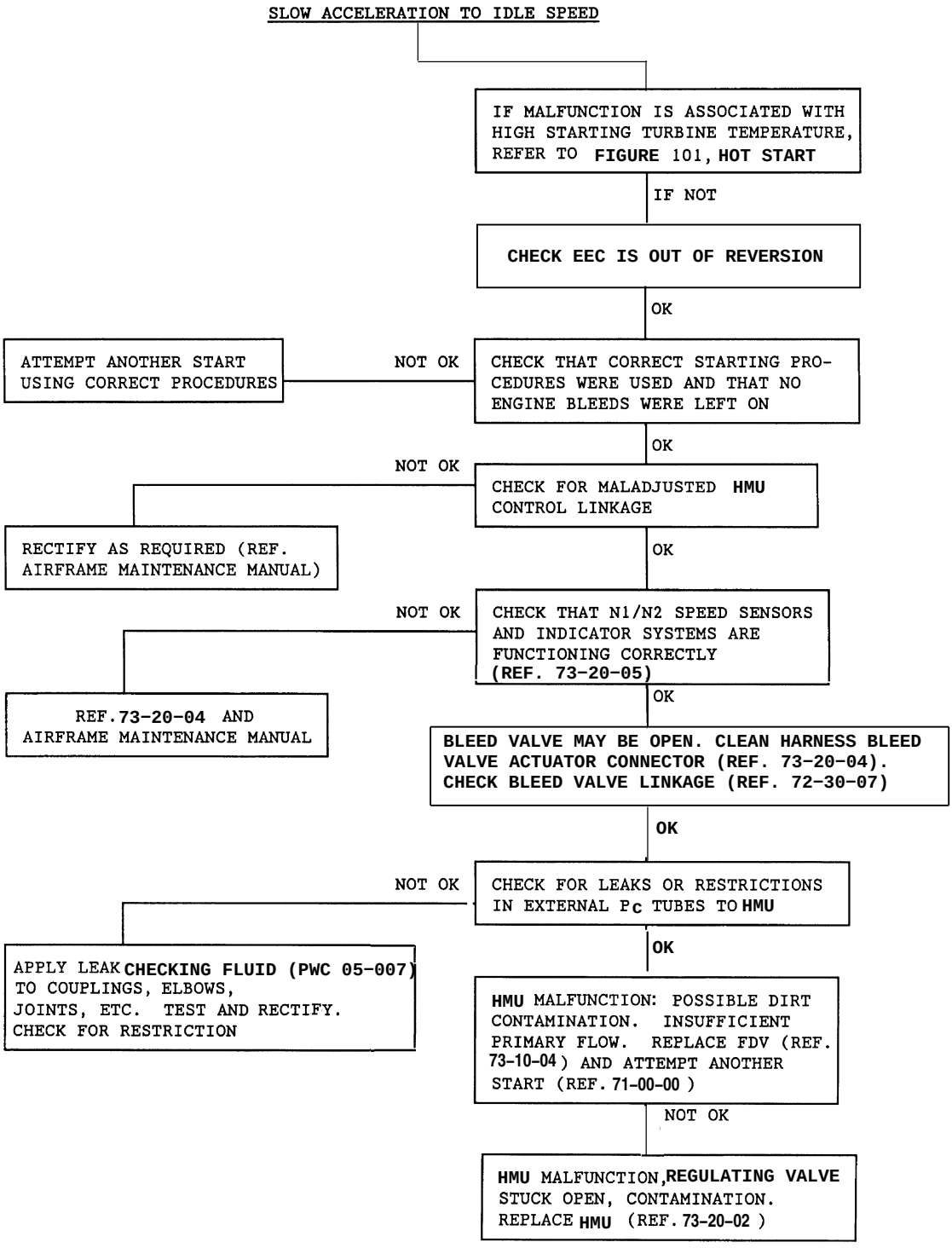
SLOW ACCELERATION TO IDLE SPEED
IF MALFUNCTION IS ASSOCIATED WITH HIGH STARTING TURBINE TEMPERATURE, REFER TO FIGURE 101, HOT START
IF NOT
CHECK EEC IS OUT OF REVERSION
OK
ATTEMPT ANOTHER START USING CORRECT PROCEDURES
NOT OK
CHECK THAT CORRECT STARTING PROCEDURES WERE USED AND THAT NO ENGINE BLEEDS WERE LEFT ON
OK
NOT OK
CHECK FOR MALADJUSTED HMU CONTROL LINKAGE
RECTIFY AS REQUIRED (REF. AIRFRAME MAINTENANCE MANUAL)
OK
NOT OK
CHECK THAT N1/N2 SPEED SENSORS AND INDICATOR SYSTEMS ARE FUNCTIONING CORRECTLY (REF. 73-20-05)
REF. 73-20-04 AND AIRFRAME MAINTENANCE MANUAL
OK
BLEED VALVE MAY BE OPEN. CLEAN HARNESS BLEED VALVE ACTUATOR CONNECTOR (REF. 73-20-04). CHECK BLEED VALVE LINKAGE (REF. 72-30-07)
OK
NOT OK
CHECK FOR LEAKS OR RESTRICTIONS IN EXTERNAL Pc TUBES TO HMU
APPLY LEAK CHECKING FLUID (PWC 05-007) TO COUPLINGS, ELBOWS, JOINTS, ETC. TEST AND RECTIFY. CHECK FOR RESTRICTION
OK
HMU MALFUNCTION: POSSIBLE DIRT CONTAMINATION. INSUFFICIENT PRIMARY FLOW. REPLACE FDV (REF. 73-10-04) AND ATTEMPT ANOTHER START (REF. 71-00-00)
NOT OK
HMU MALFUNCTION, REGULATING VALVE STUCK OPEN, CONTAMINATION. REPLACE HMU (REF. 73-20-02)

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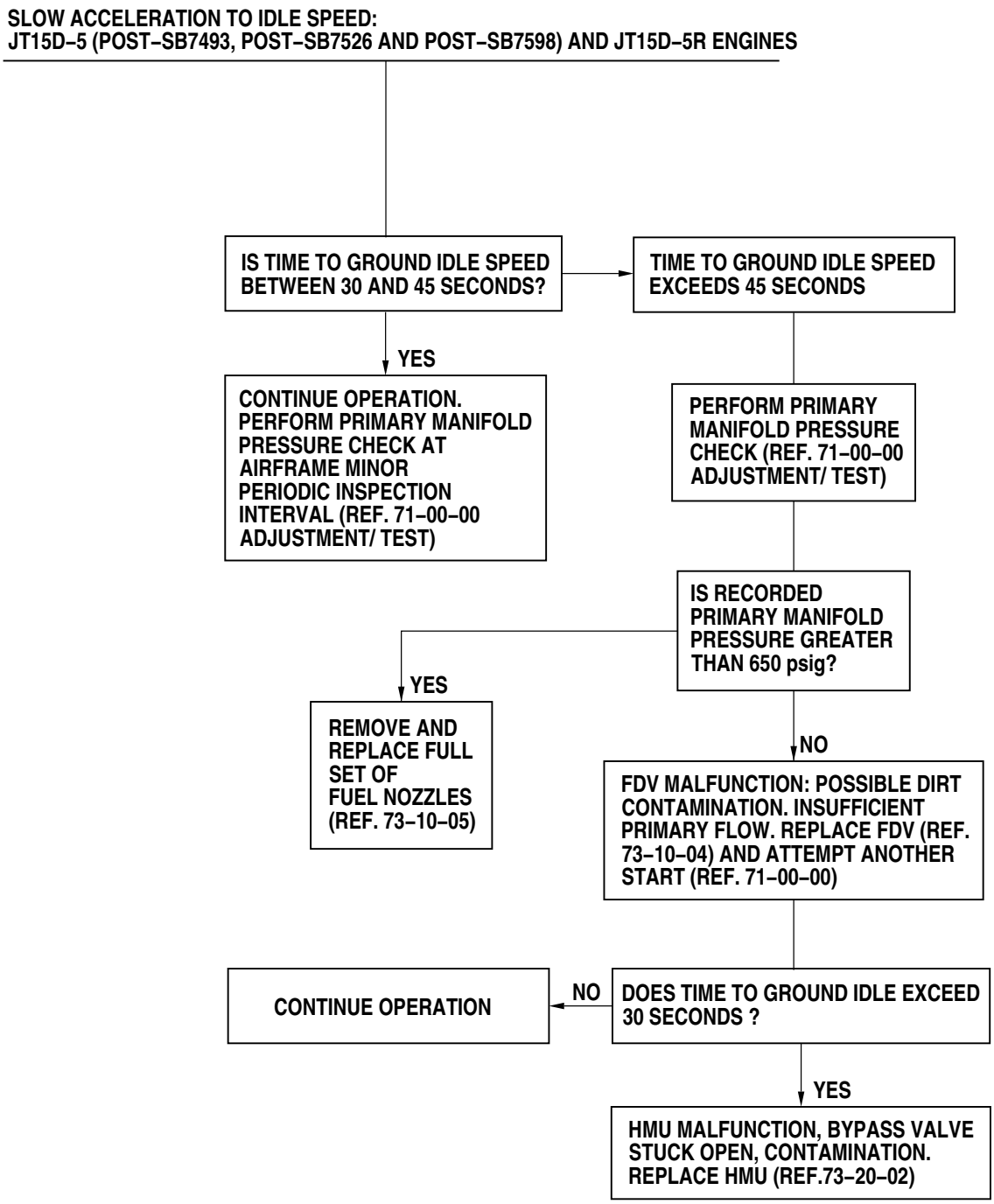
Slow Acceleration to Idle Speed
Figure 103


SLOW ACCELERATION TO IDLE SPEED:
JT15D–5 (POST–SB7493, POST–SB7526 AND POST–SB7598) AND JT15D–5R ENGINES
IS TIME TO GROUND IDLE SPEED BETWEEN 30 AND 45 SECONDS?
TIME TO GROUND IDLE SPEED EXCEEDS 45 SECONDS
YES
CONTINUE OPERATION. PERFORM PRIMARY MANIFOLD PRESSURE CHECK AT AIRFRAME MINOR PERIODIC INSPECTION INTERVAL (REF. 71–00–00 ADJUSTMENT/ TEST)
PERFORM PRIMARY MANIFOLD PRESSURE CHECK (REF. 71–00–00 ADJUSTMENT/ TEST)
IS RECORDED PRIMARY MANIFOLD PRESSURE GREATER THAN 650 psig?
YES
REMOVE AND REPLACE FULL SET OF FUEL NOZZLES (REF. 73–10–05)
NO
FDV MALFUNCTION: POSSIBLE DIRT CONTAMINATION. INSUFFICIENT PRIMARY FLOW. REPLACE FDV (REF. 73–10–04) AND ATTEMPT ANOTHER START (REF. 71–00–00)
CONTINUE OPERATION
NO
DOES TIME TO GROUND IDLE EXCEED 30 SECONDS ?
YES
HMU MALFUNCTION, BYPASS VALVE STUCK OPEN, CONTAMINATION. REPLACE HMU (REF.73–20–02)

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Slow Acceleration to Idle Speed: JT15D-5R (Post-SB7493/Post-SB7526) and JT15D-5R Engines
Figure 104

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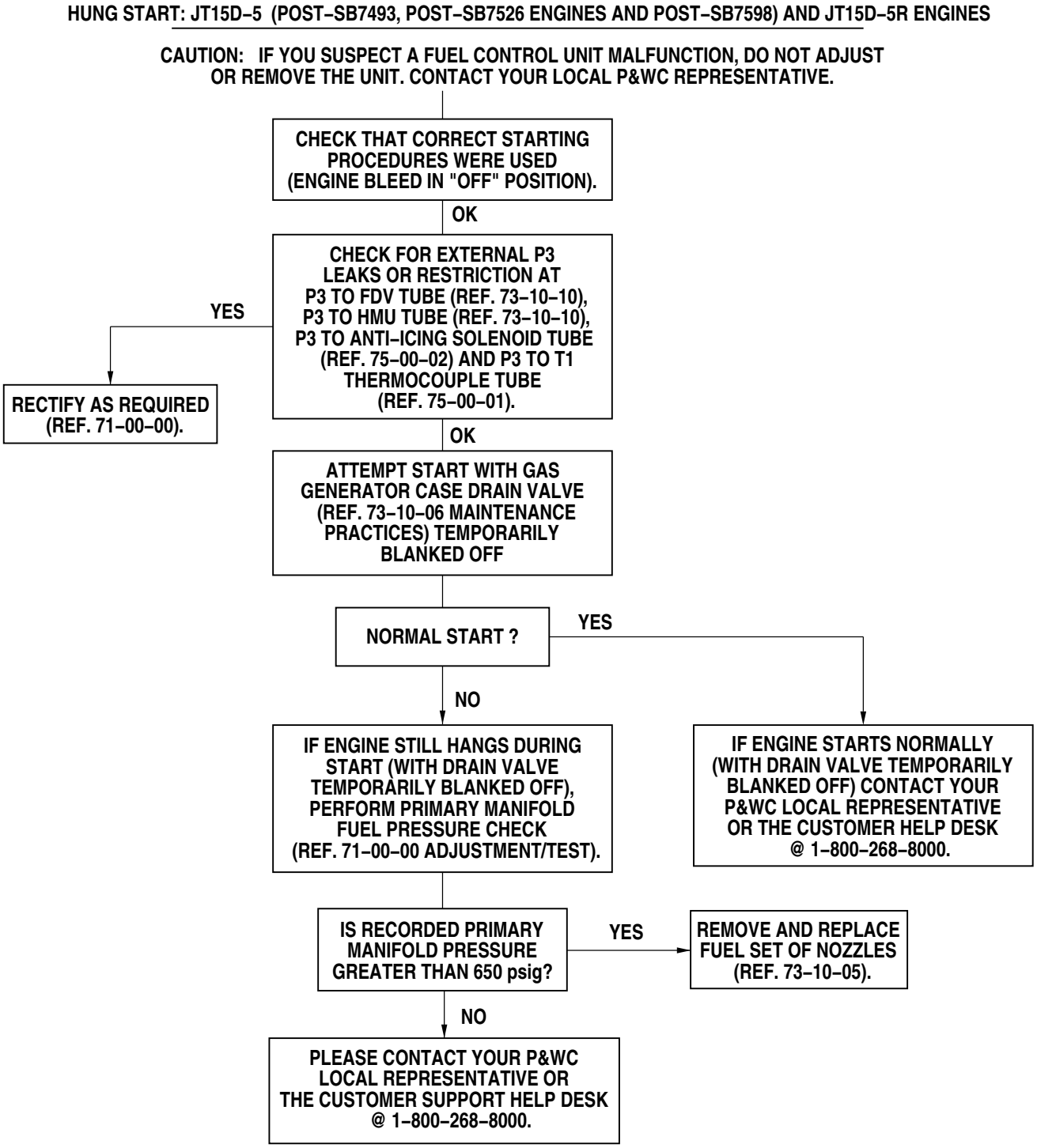
HUNG START: JT15D–5 (POST–SB7493, POST–SB7526 ENGINES AND POST–SB7598) AND JT15D–5R ENGINES
CAUTION: IF YOU SUSPECT A FUEL CONTROL UNIT MALFUNCTION, DO NOT ADJUST OR REMOVE THE UNIT. CONTACT YOUR LOCAL P&WC REPRESENTATIVE.
CHECK THAT CORRECT STARTING PROCEDURES WERE USED (ENGINE BLEED IN "OFF" POSITION).
OK
CHECK FOR EXTERNAL P3 LEAKS OR RESTRICTION AT P3 TO FDV TUBE (REF. 73–10–10), P3 TO HMU TUBE (REF. 73–10–10), P3 TO ANTI–ICING SOLENOID TUBE (REF. 75–00–02) AND P3 TO T1 THERMOCOUPLE TUBE (REF. 75–00–01).
YES
RECTIFY AS REQUIRED (REF. 71–00–00).
OK
ATTEMPT START WITH GAS GENERATOR CASE DRAIN VALVE (REF. 73–10–06 MAINTENANCE PRACTICES) TEMPORARILY BLANKED OFF
NORMAL START ?
YES
NO
IF ENGINE STILL HANGS DURING START (WITH DRAIN VALVE TEMPORARILY BLANKED OFF), PERFORM PRIMARY MANIFOLD FUEL PRESSURE CHECK (REF. 71–00–00 ADJUSTMENT/TEST).
IF ENGINE STARTS NORMALLY (WITH DRAIN VALVE TEMPORARILY BLANKED OFF) CONTACT YOUR P&WC LOCAL REPRESENTATIVE OR THE CUSTOMER HELP DESK @ 1–800–268–8000.
IS RECORDED PRIMARY MANIFOLD PRESSURE GREATER THAN 650 psig?
YES
REMOVE AND REPLACE FUEL SET OF NOZZLES (REF. 73–10–05).
NO
PLEASE CONTACT YOUR P&WC LOCAL REPRESENTATIVE OR THE CUSTOMER SUPPORT HELP DESK @ 1–800–268–8000.

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Hung Start: JT15D-5 (Post-SB7493/Post-SB7526/ Post-SB7598) and JT15D-5R Engines
Figure 105

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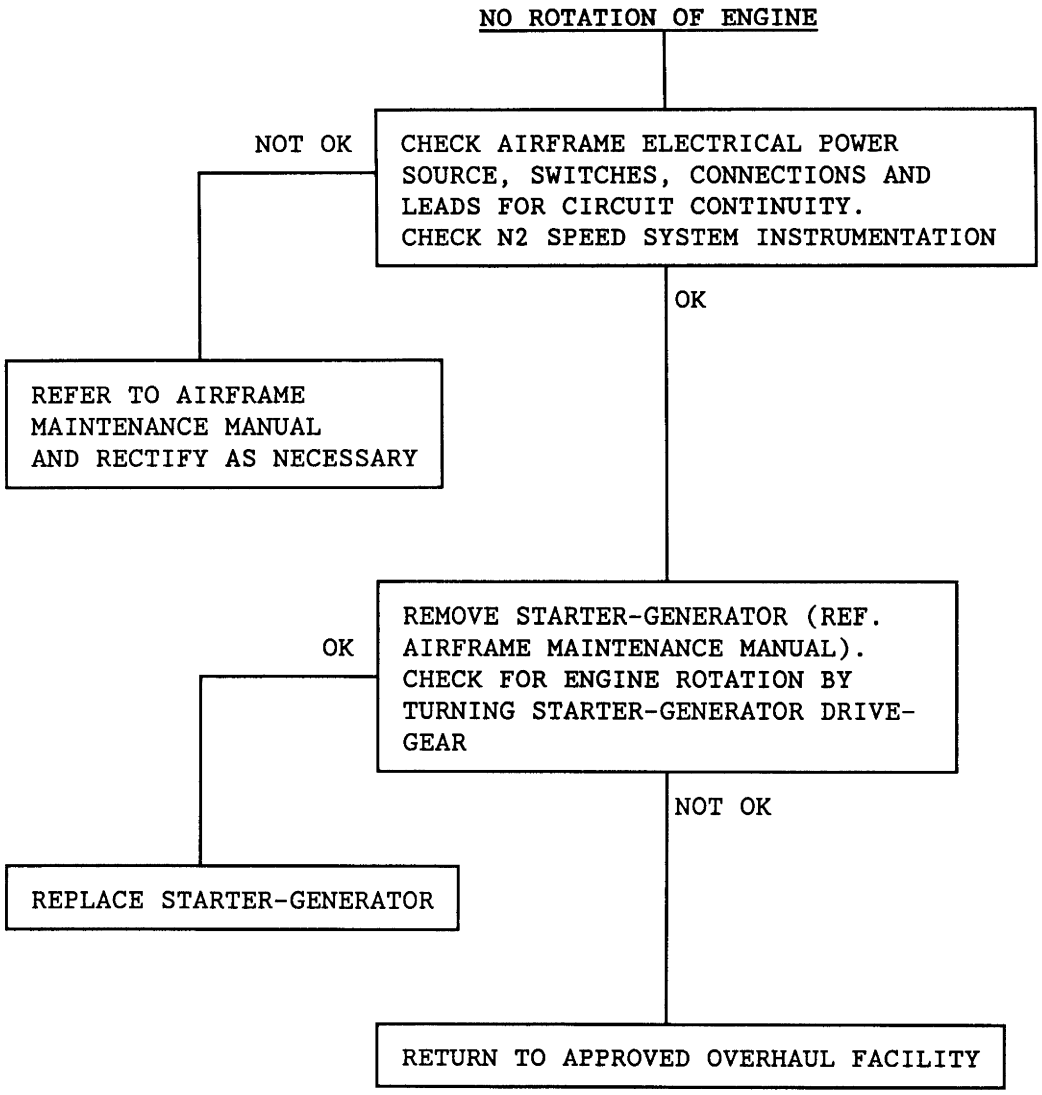
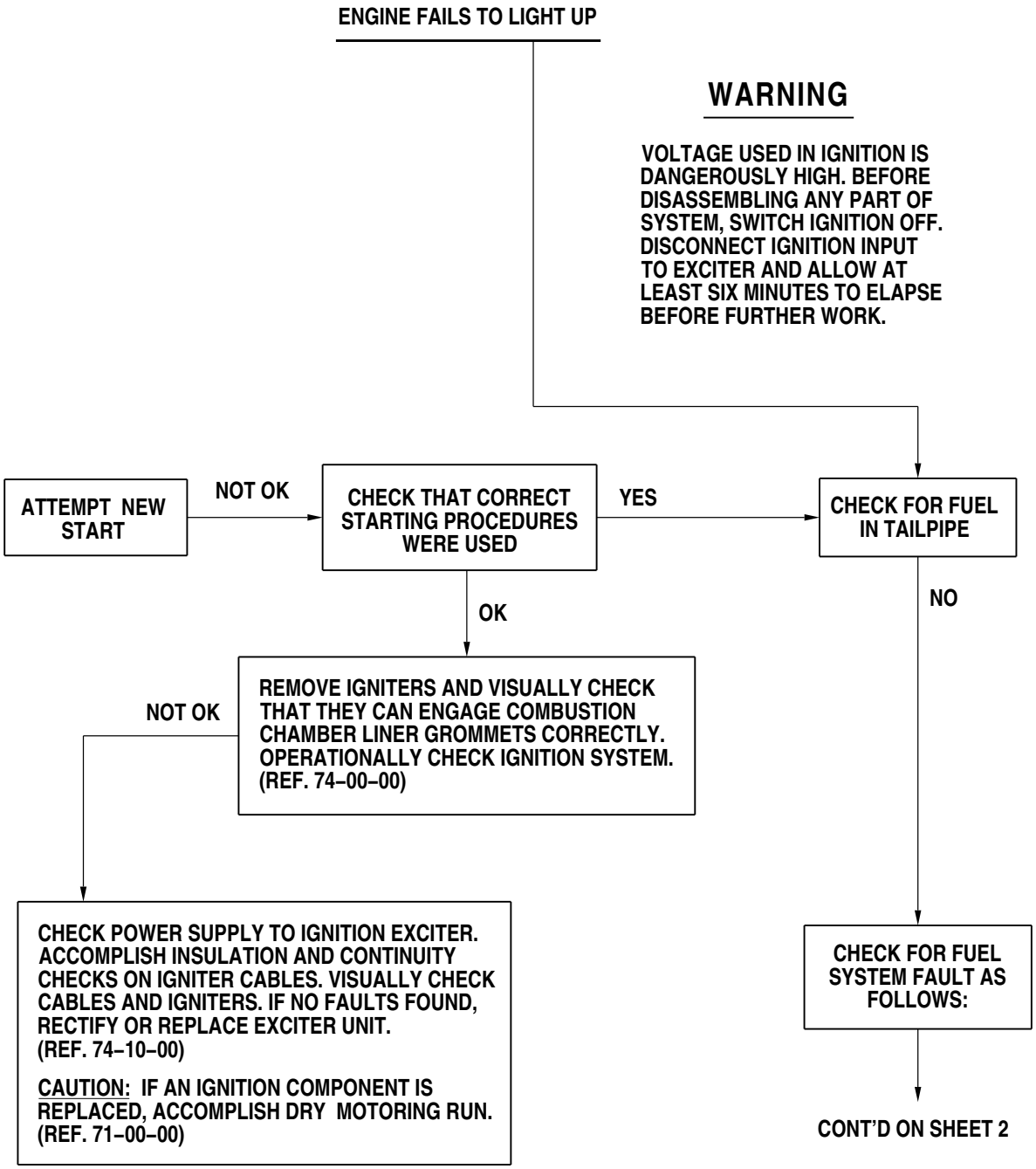

NO ROTATION OF ENGINE
CHECK AIRFRAME ELECTRICAL POWER SOURCE, SWITCHES, CONNECTIONS AND LEADS FOR CIRCUIT CONTINUITY. CHECK N2 SPEED SYSTEM INSTRUMENTATION
NOT OK
OK
REFER TO AIRFRAME MAINTENANCE MANUAL AND RECTIFY AS NECESSARY
REMOVE STARTER-GENERATOR (REF. AIRFRAME MAINTENANCE MANUAL). CHECK FOR ENGINE ROTATION BY TURNING STARTER-GENERATOR DRIVE-GEAR
OK
NOT OK
REPLACE STARTER-GENERATOR
RETURN TO APPROVED OVERHAUL FACILITY

C24531

No Rotation of Engine
Figure 106

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

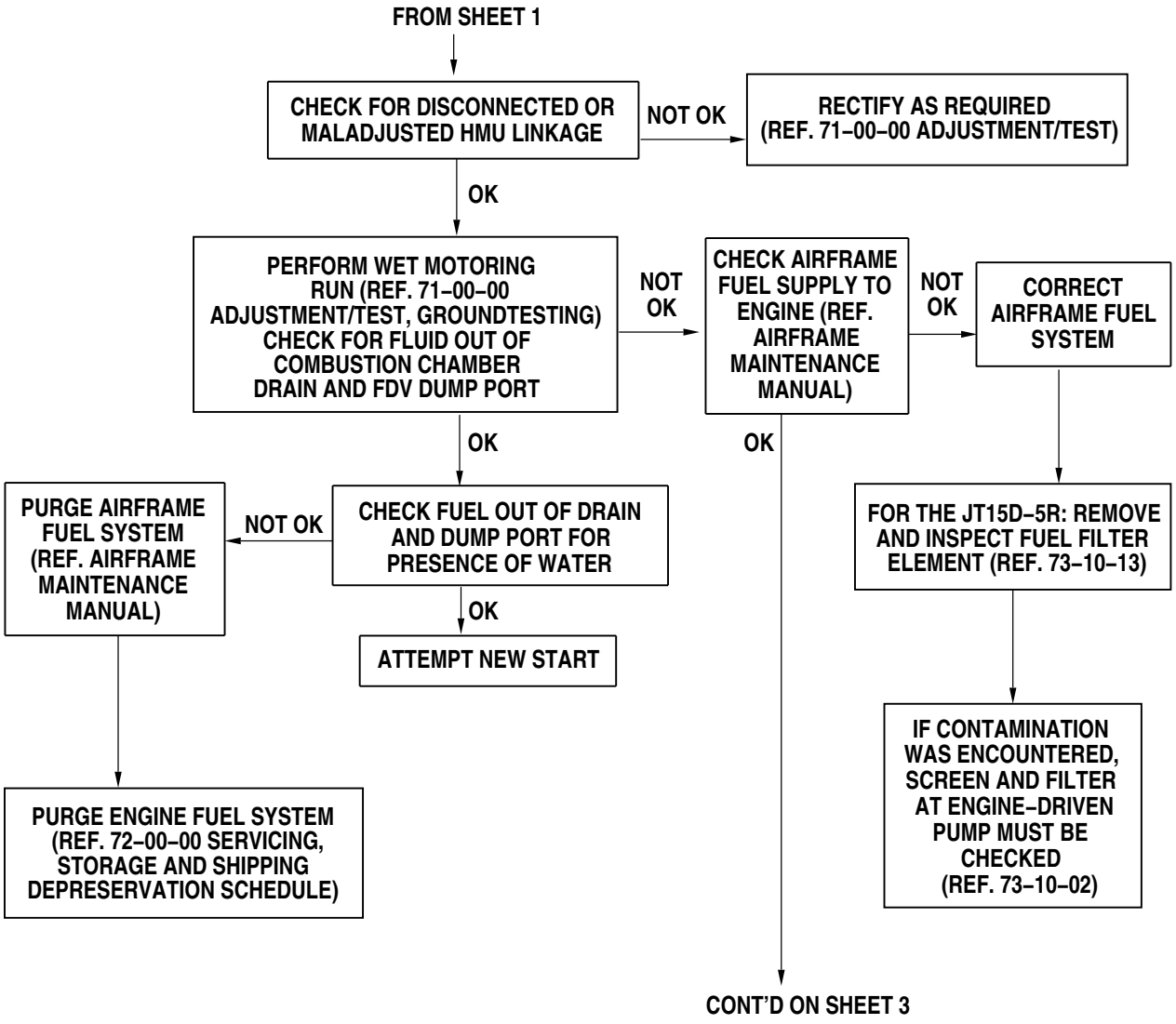

ENGINE FAILS TO LIGHT UP
WARNING
VOLTAGE USED IN IGNITION IS DANGEROUSLY HIGH. BEFORE DISASSEMBLING ANY PART OF SYSTEM, SWITCH IGNITION OFF. DISCONNECT IGNITION INPUT TO EXCITER AND ALLOW AT LEAST SIX MINUTES TO ELAPSE BEFORE FURTHER WORK.
ATTEMPT NEW START
NOT OK
CHECK THAT CORRECT STARTING PROCEDURES WERE USED
YES
CHECK FOR FUEL IN TAILPIPE
OK
NO
NOT OK
REMOVE IGNITERS AND VISUALLY CHECK THAT THEY CAN ENGAGE COMBUSTION CHAMBER LINER GROMMETS CORRECTLY. OPERATIONALLY CHECK IGNITION SYSTEM. (REF. 74–00–00)
CHECK POWER SUPPLY TO IGNITION EXCITER. ACCOMPLISH INSULATION AND CONTINUITY CHECKS ON IGNITER CABLES. VISUALLY CHECK CABLES AND IGNITERS. IF NO FAULTS FOUND, RECTIFY OR REPLACE EXCITER UNIT. (REF. 74–10–00)
CAUTION: IF AN IGNITION COMPONENT IS REPLACED, ACCOMPLISH DRY MOTORING RUN. (REF. 71–00–00)
CHECK FOR FUEL SYSTEM FAULT AS FOLLOWS:
CONT'D ON SHEET 2

C24532B

Engine Fails to Light Up
Figure 107 (Sheet 1 of 3)

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

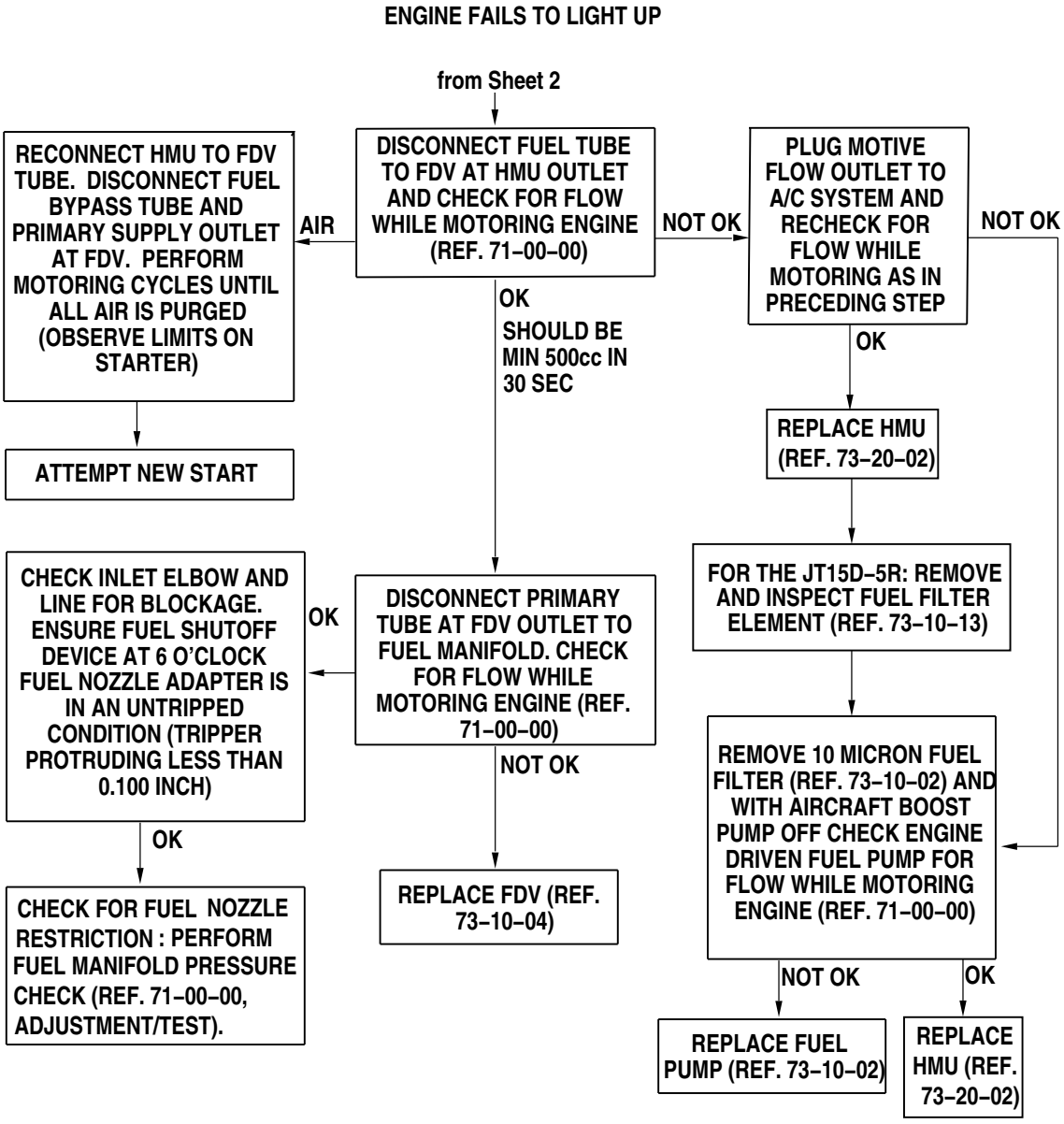
ENGINE FAILS TO LIGHT UP


FROM SHEET 1
CHECK FOR DISCONNECTED OR MALADJUSTED HMU LINKAGE
NOT OK
RECTIFY AS REQUIRED (REF. 71–00–00 ADJUSTMENT/TEST)
OK
PERFORM WET MOTORING RUN (REF. 71–00–00 ADJUSTMENT/TEST, GROUNDTESTING) CHECK FOR FLUID OUT OF COMBUSTION CHAMBER DRAIN AND FDV DUMP PORT
NOT OK
CHECK AIRFRAME FUEL SUPPLY TO ENGINE (REF. AIRFRAME MAINTENANCE MANUAL)
NOT OK
CORRECT AIRFRAME FUEL SYSTEM
OK
OK
PURGE AIRFRAME FUEL SYSTEM (REF. AIRFRAME MAINTENANCE MANUAL)
NOT OK
CHECK FUEL OUT OF DRAIN AND DUMP PORT FOR PRESENCE OF WATER
FOR THE JT15D–5R: REMOVE AND INSPECT FUEL FILTER ELEMENT (REF. 73–10–13)
OK
ATTEMPT NEW START
IF CONTAMINATION WAS ENCOUNTERED, SCREEN AND FILTER AT ENGINE–DRIVEN PUMP MUST BE CHECKED (REF. 73–10–02)
PURGE ENGINE FUEL SYSTEM (REF. 72–00–00 SERVICING, STORAGE AND SHIPPING DEPRESERVATION SCHEDULE)
CONT'D ON SHEET 3

C29811B

Engine Fails to Light Up
Figure 107 (Sheet 2)

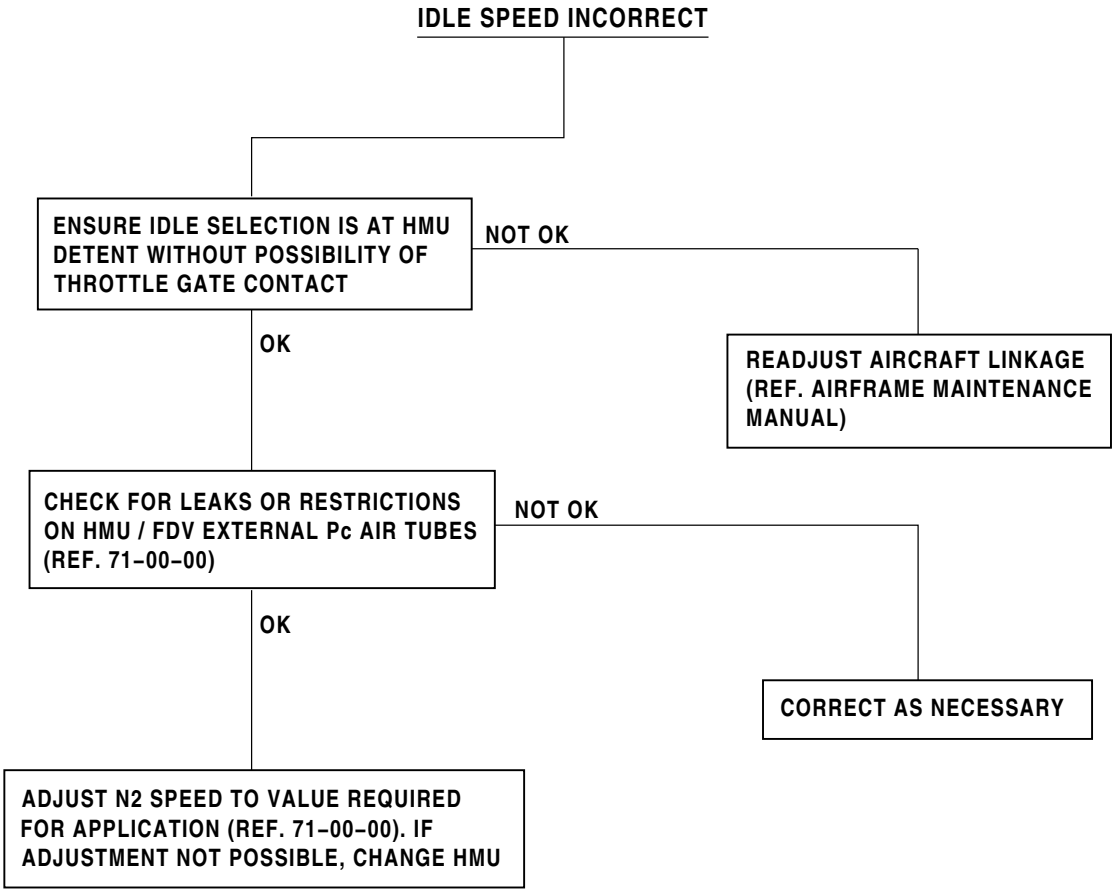
P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.


ENGINE FAILS TO LIGHT UP
from Sheet 2
DISCONNECT FUEL TUBE TO FDV AT HMU OUTLET AND CHECK FOR FLOW WHILE MOTORING ENGINE (REF. 71–00–00)
AIR
RECONNECT HMU TO FDV TUBE. DISCONNECT FUEL BYPASS TUBE AND PRIMARY SUPPLY OUTLET AT FDV. PERFORM MOTORING CYCLES UNTIL ALL AIR IS PURGED (OBSERVE LIMITS ON STARTER)
ATTEMPT NEW START
NOT OK
PLUG MOTIVE FLOW OUTLET TO A/C SYSTEM AND RECHECK FOR FLOW WHILE MOTORING AS IN PRECEDING STEP
NOT OK
OK
REPLACE HMU (REF. 73–20–02)
OK
SHOULD BE MIN 500cc IN 30 SEC
FOR THE JT15D–5R: REMOVE AND INSPECT FUEL FILTER ELEMENT (REF. 73–10–13)
REMOVE 10 MICRON FUEL FILTER (REF. 73–10–02) AND WITH AIRCRAFT BOOST PUMP OFF CHECK ENGINE DRIVEN FUEL PUMP FOR FLOW WHILE MOTORING ENGINE (REF. 71–00–00)
NOT OK
OK
REPLACE FUEL PUMP (REF. 73–10–02)
REPLACE HMU (REF. 73–20–02)
DISCONNECT PRIMARY TUBE AT FDV OUTLET TO FUEL MANIFOLD. CHECK FOR FLOW WHILE MOTORING ENGINE (REF. 71–00–00)
OK
CHECK INLET ELBOW AND LINE FOR BLOCKAGE. ENSURE FUEL SHUTOFF DEVICE AT 6 O'CLOCK FUEL NOZZLE ADAPTER IS IN AN UNTRIPPED CONDITION (TRIPPER PROTRUDING LESS THAN 0.100 INCH)
OK
CHECK FOR FUEL NOZZLE RESTRICTION : PERFORM FUEL MANIFOLD PRESSURE CHECK (REF. 71–00–00, ADJUSTMENT/TEST).
NOT OK
REPLACE FDV (REF. 73–10–04)

C29812C

Engine Fails to Light Up
Figure 107 (Sheet 3)

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.


IDLE SPEED INCORRECT
ENSURE IDLE SELECTION IS AT HMU DETENT WITHOUT POSSIBILITY OF THROTTLE GATE CONTACT
NOT OK
READJUST AIRCRAFT LINKAGE (REF. AIRFRAME MAINTENANCE MANUAL)
OK
CHECK FOR LEAKS OR RESTRICTIONS ON HMU / FDV EXTERNAL Pc AIR TUBES (REF. 71–00–00)
NOT OK
CORRECT AS NECESSARY
OK
ADJUST N2 SPEED TO VALUE REQUIRED FOR APPLICATION (REF. 71–00–00). IF ADJUSTMENT NOT POSSIBLE, CHANGE HMU

C29813A

Idle Speed Incorrect
Figure 108

P&WC Proprietary Information. Subject to the restriction on the title page.
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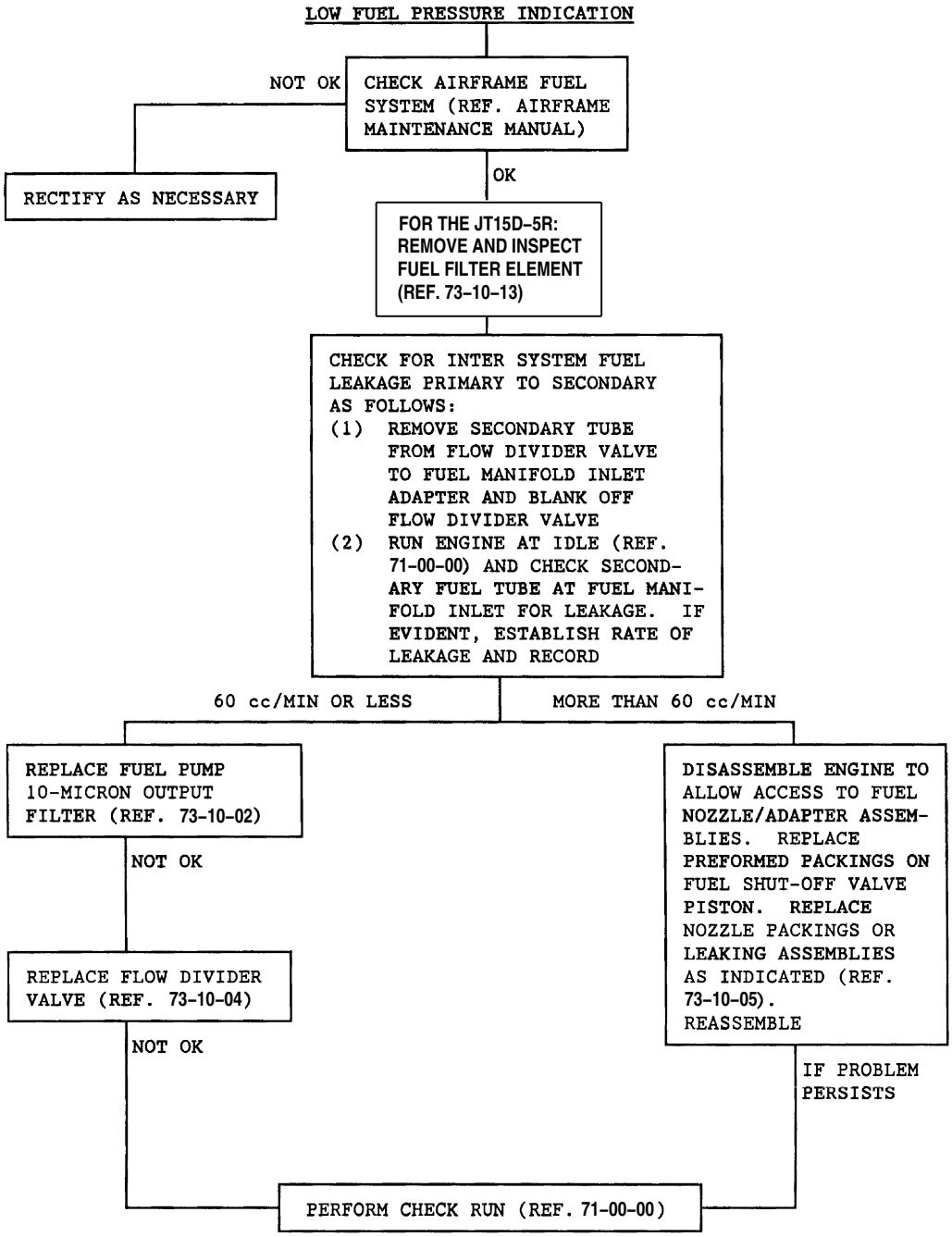
LOW FUEL PRESSURE INDICATION
NOT OK
CHECK AIRFRAME FUEL SYSTEM (REF. AIRFRAME MAINTENANCE MANUAL)
RECTIFY AS NECESSARY
OK
FOR THE JT15D-5R: REMOVE AND INSPECT FUEL FILTER ELEMENT (REF. 73-10-13)
CHECK FOR INTER SYSTEM FUEL LEAKAGE PRIMARY TO SECONDARY AS FOLLOWS:
(1) REMOVE SECONDARY TUBE FROM FLOW DIVIDER VALVE TO FUEL MANIFOLD INLET ADAPTER AND BLANK OFF FLOW DIVIDER VALVE
(2) RUN ENGINE AT IDLE (REF. 71-00-00) AND CHECK SECONDARY FUEL TUBE AT FUEL MANIFOLD INLET FOR LEAKAGE. IF EVIDENT, ESTABLISH RATE OF LEAKAGE AND RECORD
60 cc/MIN OR LESS
MORE THAN 60 cc/MIN
REPLACE FUEL PUMP 10-MICRON OUTPUT FILTER (REF. 73-10-02)
NOT OK
REPLACE FLOW DIVIDER VALVE (REF. 73-10-04)
NOT OK
DISASSEMBLE ENGINE TO ALLOW ACCESS TO FUEL NOZZLE/ADAPTER ASSEMBLIES. REPLACE PREFORMED PACKINGS ON FUEL SHUT-OFF VALVE PISTON. REPLACE NOZZLE PACKINGS OR LEAKING ASSEMBLIES AS INDICATED (REF. 73-10-05). REASSEMBLE
IF PROBLEM PERSISTS
PERFORM CHECK RUN (REF. 71-00-00)

C24537A

Low Fuel Pressure Indication
Figure 109

P&WC Proprietary Information. Subject to the restriction on the title page.
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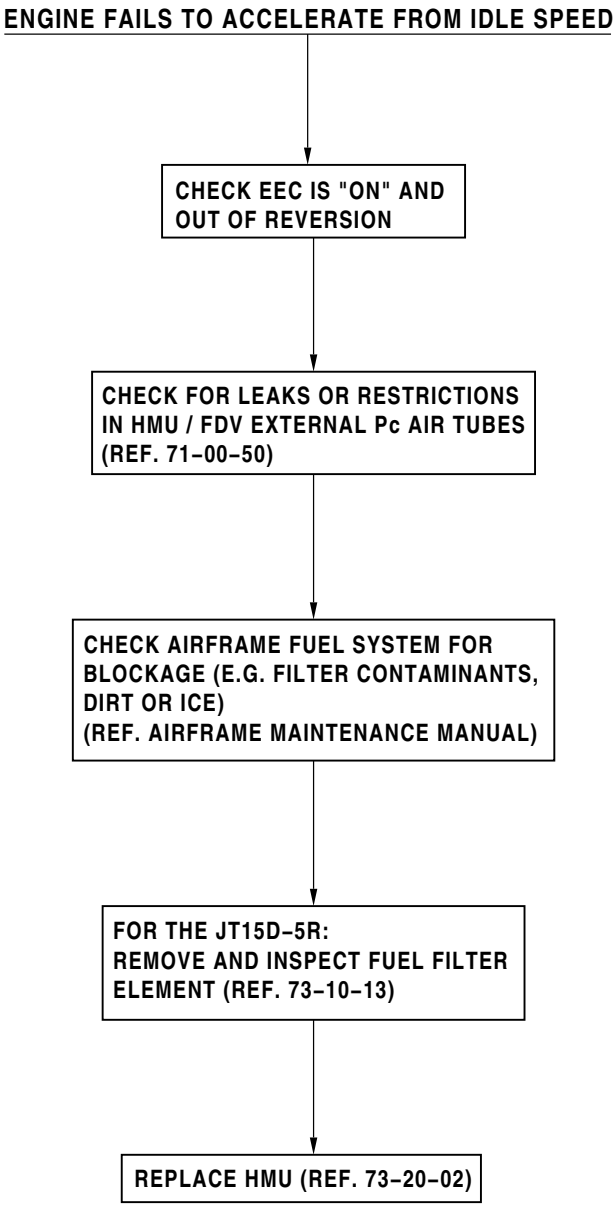
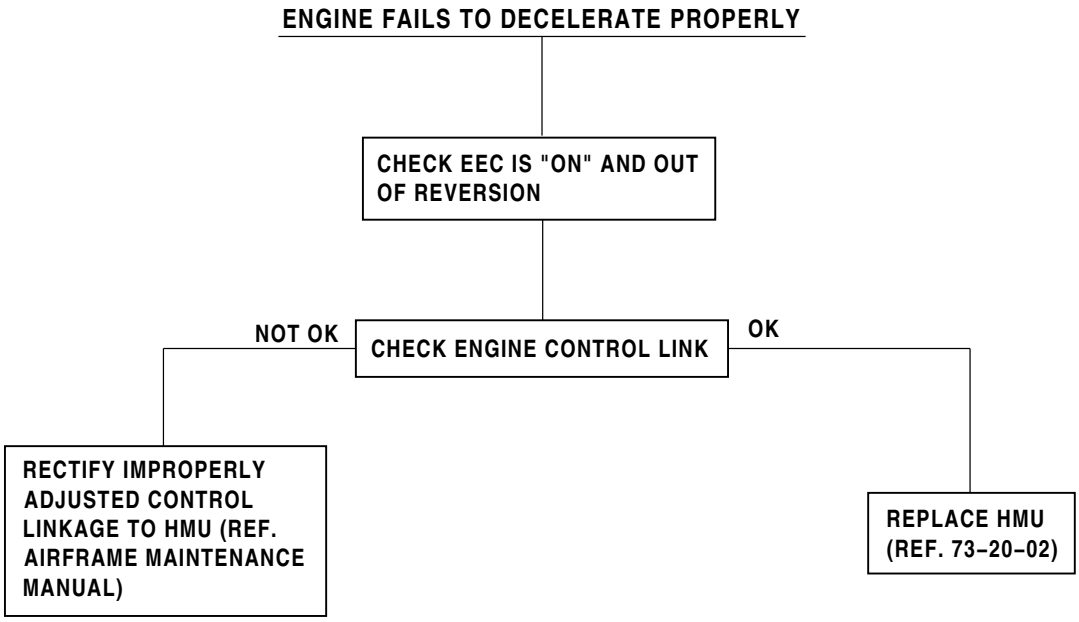

ENGINE FAILS TO ACCELERATE FROM IDLE SPEED
CHECK EEC IS "ON" AND OUT OF REVERSION
CHECK FOR LEAKS OR RESTRICTIONS IN HMU / FDV EXTERNAL Pc AIR TUBES (REF. 71–00–50)
CHECK AIRFRAME FUEL SYSTEM FOR BLOCKAGE (E.G. FILTER CONTAMINANTS, DIRT OR ICE) (REF. AIRFRAME MAINTENANCE MANUAL)
FOR THE JT15D–5R: REMOVE AND INSPECT FUEL FILTER ELEMENT (REF. 73–10–13)
REPLACE HMU (REF. 73–20–02)

C29814A

Engine Fails to Accelerate From Idle Speed
Figure 110

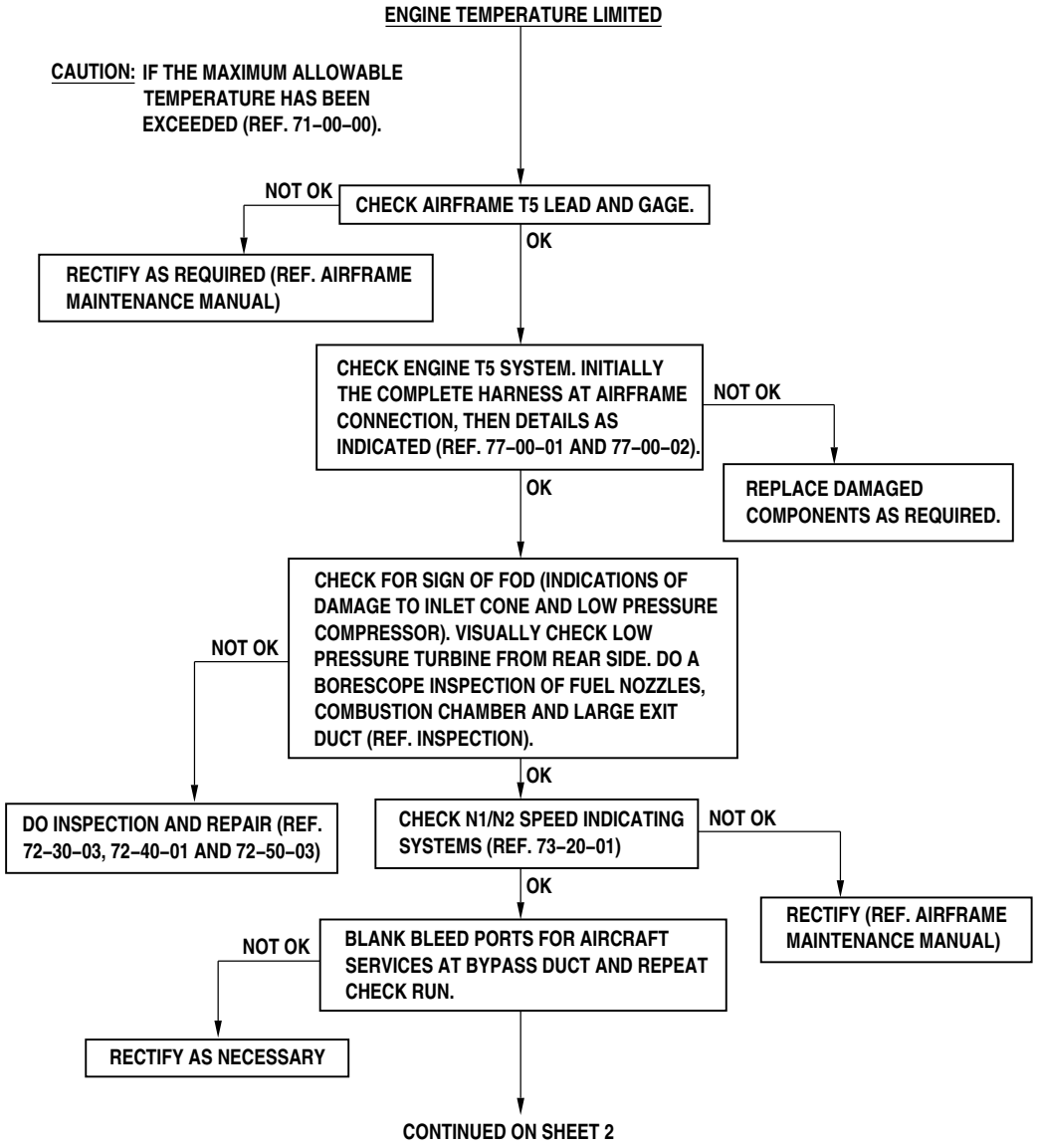
P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.


ENGINE FAILS TO DECELERATE PROPERLY
CHECK EEC IS "ON" AND OUT OF REVERSION
NOT OK
CHECK ENGINE CONTROL LINK
OK
RECTIFY IMPROPERLY ADJUSTED CONTROL LINKAGE TO HMU (REF. AIRFRAME MAINTENANCE MANUAL)
REPLACE HMU (REF. 73–20–02)

C29818

Engine Fails to Decelerate Properly
Figure 111

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.


ENGINE TEMPERATURE LIMITED
CAUTION: IF THE MAXIMUM ALLOWABLE TEMPERATURE HAS BEEN EXCEEDED (REF. 71–00–00).
CHECK AIRFRAME T5 LEAD AND GAGE.
NOT OK
RECTIFY AS REQUIRED (REF. AIRFRAME MAINTENANCE MANUAL)
OK
CHECK ENGINE T5 SYSTEM. INITIALLY THE COMPLETE HARNESS AT AIRFRAME CONNECTION, THEN DETAILS AS INDICATED (REF. 77–00–01 AND 77–00–02).
NOT OK
REPLACE DAMAGED COMPONENTS AS REQUIRED.
OK
CHECK FOR SIGN OF FOD (INDICATIONS OF DAMAGE TO INLET CONE AND LOW PRESSURE COMPRESSOR). VISUALLY CHECK LOW PRESSURE TURBINE FROM REAR SIDE. DO A BORESCOPE INSPECTION OF FUEL NOZZLES, COMBUSTION CHAMBER AND LARGE EXIT DUCT (REF. INSPECTION).
NOT OK
DO INSPECTION AND REPAIR (REF. 72–30–03, 72–40–01 AND 72–50–03)
OK
CHECK N1/N2 SPEED INDICATING SYSTEMS (REF. 73–20–01)
NOT OK
RECTIFY (REF. AIRFRAME MAINTENANCE MANUAL)
OK
BLANK BLEED PORTS FOR AIRCRAFT SERVICES AT BYPASS DUCT AND REPEAT CHECK RUN.
NOT OK
RECTIFY AS NECESSARY
CONTINUED ON SHEET 2

C229367

Engine Temperature Limited
Figure 112 (Sheet 1 of 2)

P&WC Proprietary Information. Subject to the restriction on the title page.
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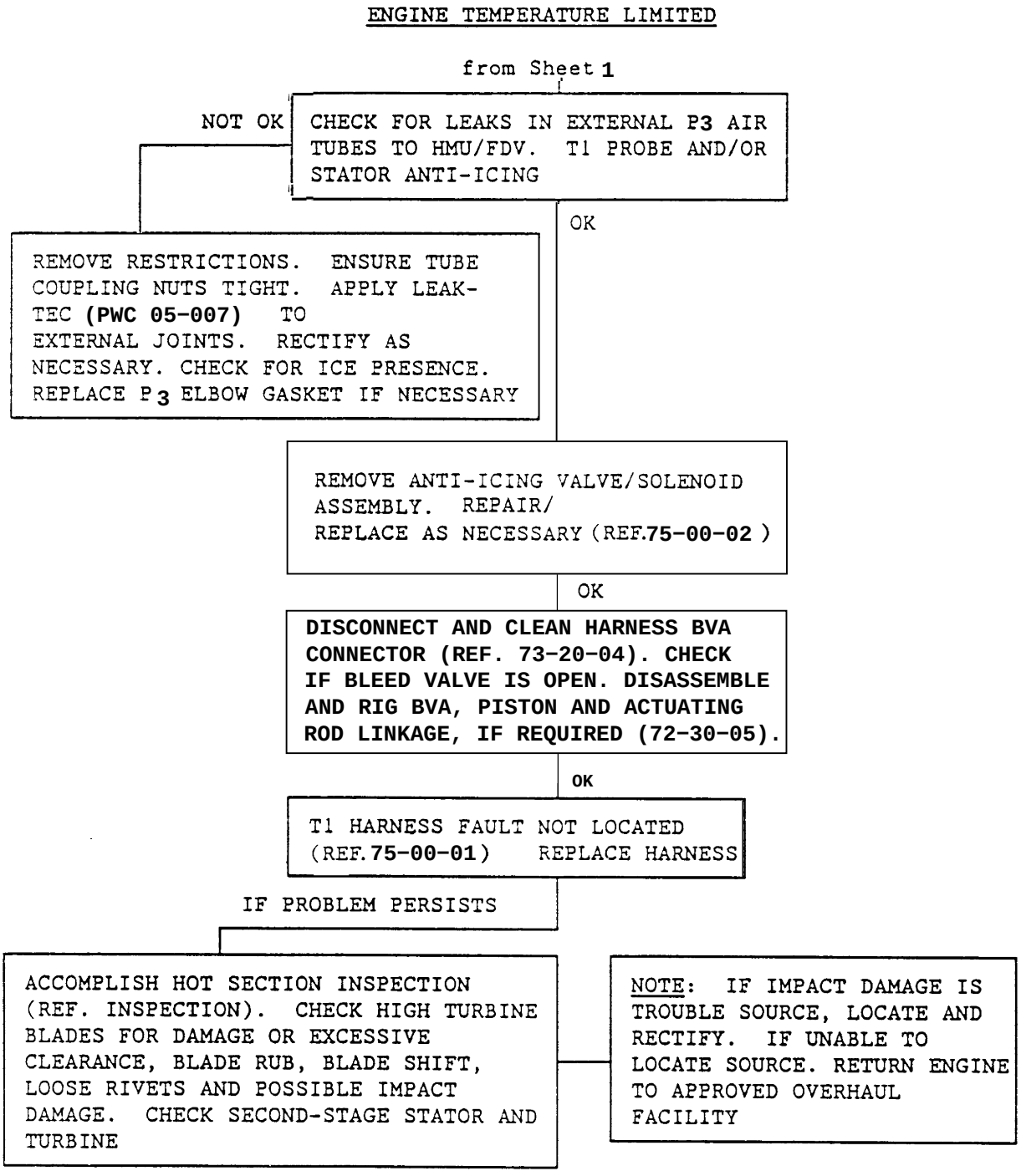
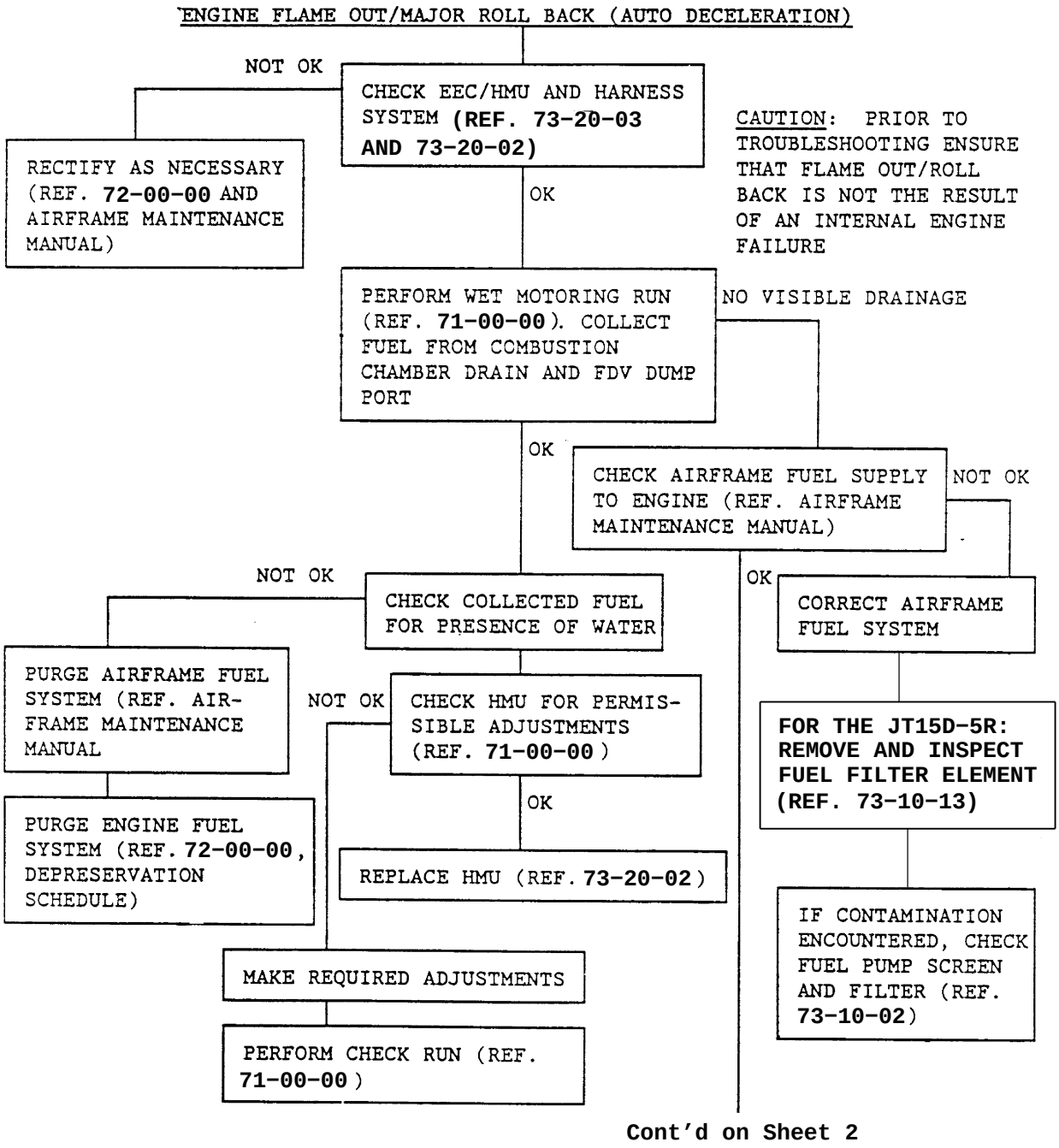

ENGINE TEMPERATURE LIMITED
from Sheet 1
NOT OK
CHECK FOR LEAKS IN EXTERNAL P3 AIR TUBES TO HMU/FDV. T1 PROBE AND/OR STATOR ANTI-ICING
OK
REMOVE RESTRICTIONS. ENSURE TUBE COUPLING NUTS TIGHT. APPLY LEAK-TEC (PWC 05-007) TO EXTERNAL JOINTS. RECTIFY AS NECESSARY. CHECK FOR ICE PRESENCE. REPLACE P3 ELBOW GASKET IF NECESSARY
REMOVE ANTI-ICING VALVE/SOLENOID ASSEMBLY. REPAIR/ REPLACE AS NECESSARY (REF.75-00-02)
OK
DISCONNECT AND CLEAN HARNESS BVA CONNECTOR (REF. 73-20-04). CHECK IF BLEED VALVE IS OPEN. DISASSEMBLE AND RIG BVA, PISTON AND ACTUATING ROD LINKAGE, IF REQUIRED (72-30-05).
OK
T1 HARNESS FAULT NOT LOCATED (REF.75-00-01) REPLACE HARNESS
IF PROBLEM PERSISTS
ACCOMPLISH HOT SECTION INSPECTION (REF. INSPECTION). CHECK HIGH TURBINE BLADES FOR DAMAGE OR EXCESSIVE CLEARANCE, BLADE RUB, BLADE SHIFT, LOOSE RIVETS AND POSSIBLE IMPACT DAMAGE. CHECK SECOND-STAGE STATOR AND TURBINE
NOTE: IF IMPACT DAMAGE IS TROUBLE SOURCE, LOCATE AND RECTIFY. IF UNABLE TO LOCATE SOURCE. RETURN ENGINE TO APPROVED OVERHAUL FACILITY

C29821B

Engine Temperature Limited
Figure 112 (Sheet 2)

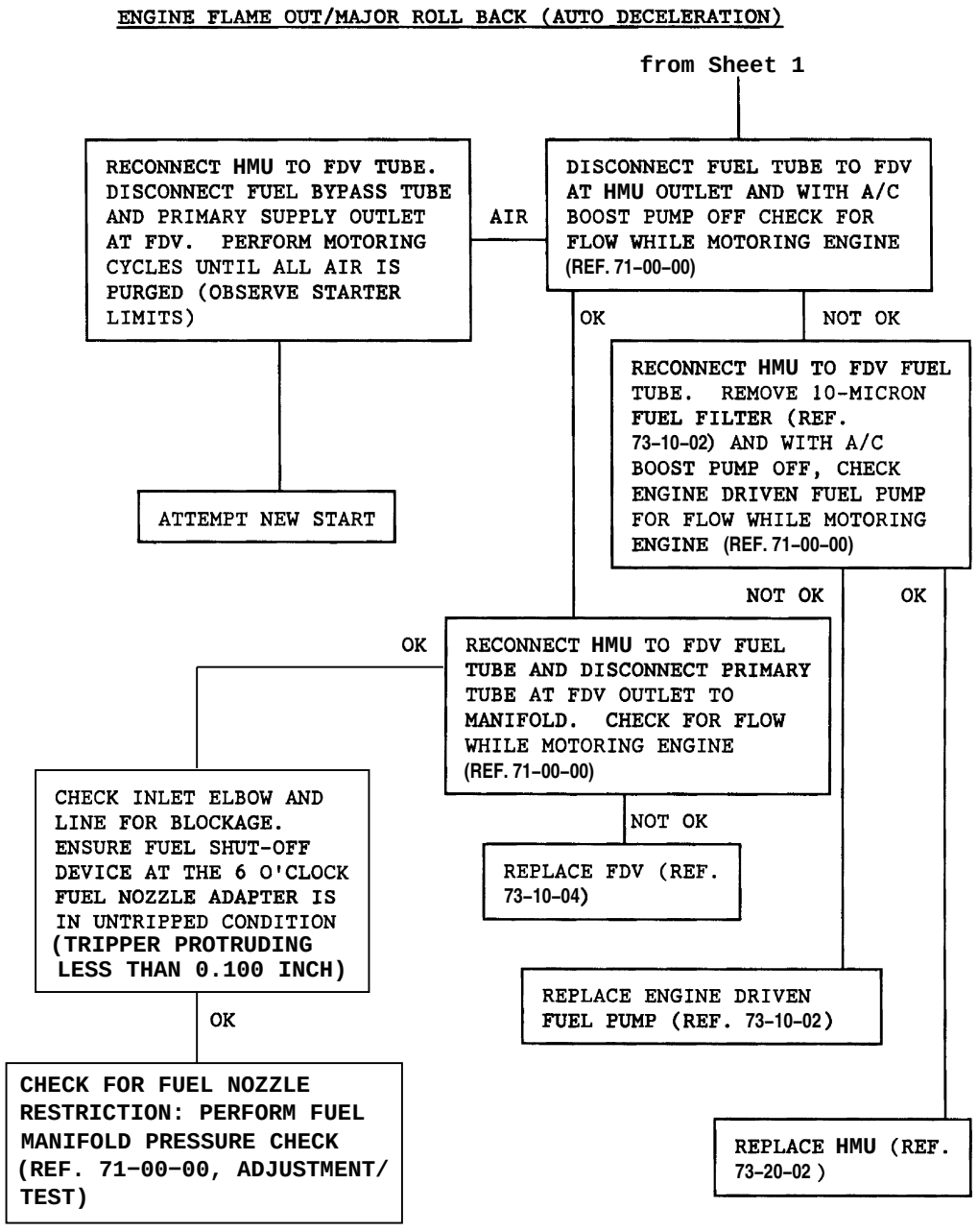
P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.


ENGINE FLAME OUT/MAJOR ROLL BACK (AUTO DECELERATION)
NOT OK
CHECK EEC/HMU AND HARNESS SYSTEM (REF. 73-20-03 AND 73-20-02)
RECTIFY AS NECESSARY (REF. 72-00-00 AND AIRFRAME MAINTENANCE MANUAL)
OK
CAUTION: PRIOR TO TROUBLESHOOTING ENSURE THAT FLAME OUT/ROLL BACK IS NOT THE RESULT OF AN INTERNAL ENGINE FAILURE
PERFORM WET MOTORING RUN (REF. 71-00-00). COLLECT FUEL FROM COMBUSTION CHAMBER DRAIN AND FDV DUMP PORT
NO VISIBLE DRAINAGE
OK
CHECK AIRFRAME FUEL SUPPLY TO ENGINE (REF. AIRFRAME MAINTENANCE MANUAL)
NOT OK
OK
CORRECT AIRFRAME FUEL SYSTEM
FOR THE JT15D-5R: REMOVE AND INSPECT FUEL FILTER ELEMENT (REF. 73-10-13)
IF CONTAMINATION ENCOUNTERED, CHECK FUEL PUMP SCREEN AND FILTER (REF. 73-10-02)
NOT OK
CHECK COLLECTED FUEL FOR PRESENCE OF WATER
PURGE AIRFRAME FUEL SYSTEM (REF. AIRFRAME MAINTENANCE MANUAL
NOT OK
CHECK HMU FOR PERMISSIBLE ADJUSTMENTS (REF. 71-00-00)
OK
PURGE ENGINE FUEL SYSTEM (REF. 72-00-00, DEPRESERVATION SCHEDULE)
REPLACE HMU (REF. 73-20-02)
MAKE REQUIRED ADJUSTMENTS
PERFORM CHECK RUN (REF. 71-00-00)
Cont'd on Sheet 2

C29819B

Engine Flame Out/Major Roll Back (Auto Deceleration)
Figure 113 (Sheet 1 of 2)

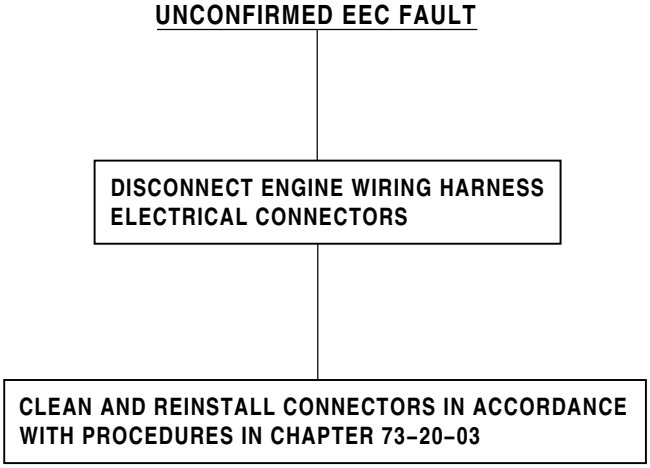
P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.


ENGINE FLAME OUT/MAJOR ROLL BACK (AUTO DECELERATION)
from Sheet 1
DISCONNECT FUEL TUBE TO FDV AT HMU OUTLET AND WITH A/C BOOST PUMP OFF CHECK FOR FLOW WHILE MOTORING ENGINE (REF. 71-00-00)
AIR
RECONNECT HMU TO FDV TUBE. DISCONNECT FUEL BYPASS TUBE AND PRIMARY SUPPLY OUTLET AT FDV. PERFORM MOTORING CYCLES UNTIL ALL AIR IS PURGED (OBSERVE STARTER LIMITS)
ATTEMPT NEW START
OK
NOT OK
RECONNECT HMU TO FDV FUEL TUBE. REMOVE 10-MICRON FUEL FILTER (REF. 73-10-02) AND WITH A/C BOOST PUMP OFF, CHECK ENGINE DRIVEN FUEL PUMP FOR FLOW WHILE MOTORING ENGINE (REF. 71-00-00)
NOT OK
OK
OK
RECONNECT HMU TO FDV FUEL TUBE AND DISCONNECT PRIMARY TUBE AT FDV OUTLET TO MANIFOLD. CHECK FOR FLOW WHILE MOTORING ENGINE (REF. 71-00-00)
NOT OK
REPLACE FDV (REF. 73-10-04)
CHECK INLET ELBOW AND LINE FOR BLOCKAGE. ENSURE FUEL SHUT-OFF DEVICE AT THE 6 O'CLOCK FUEL NOZZLE ADAPTER IS IN UNTRIPPED CONDITION (TRIPPER PROTRUDING LESS THAN 0.100 INCH)
REPLACE ENGINE DRIVEN FUEL PUMP (REF. 73-10-02)
OK
CHECK FOR FUEL NOZZLE RESTRICTION: PERFORM FUEL MANIFOLD PRESSURE CHECK (REF. 71-00-00, ADJUSTMENT/ TEST)
REPLACE HMU (REF. 73-20-02)

C29822A

Engine Flame Out/Major Roll Back (Auto Deceleration)
Figure 113 (Sheet 2)

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.


UNCONFIRMED EEC FAULT
DISCONNECT ENGINE WIRING HARNESS ELECTRICAL CONNECTORS
CLEAN AND REINSTALL CONNECTORS IN ACCORDANCE WITH PROCEDURES IN CHAPTER 73–20–03

C29823

Unconfirmed EEC Fault
Figure 114

P&WC Proprietary Information. Subject to the restriction on the title page.
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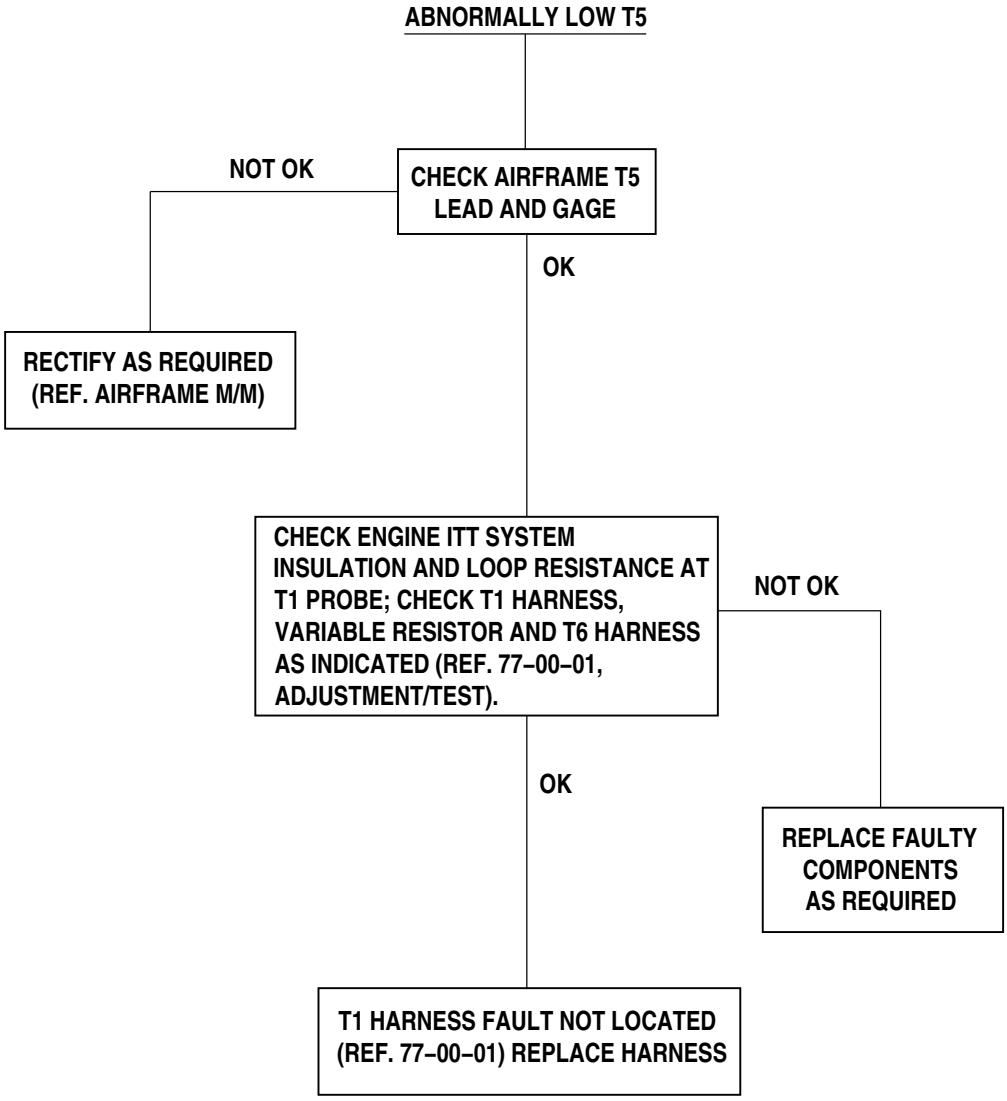
ABNORMALLY LOW T5
CHECK AIRFRAME T5 LEAD AND GAGE
NOT OK
RECTIFY AS REQUIRED (REF. AIRFRAME M/M)
OK
CHECK ENGINE ITT SYSTEM INSULATION AND LOOP RESISTANCE AT T1 PROBE; CHECK T1 HARNESS, VARIABLE RESISTOR AND T6 HARNESS AS INDICATED (REF. 77–00–01, ADJUSTMENT/TEST).
NOT OK
REPLACE FAULTY COMPONENTS AS REQUIRED
OK
T1 HARNESS FAULT NOT LOCATED (REF. 77–00–01) REPLACE HARNESS

C24549B

Abnormally Low T5
Figure 115

P&WC Proprietary Information. Subject to the restriction on the title page.
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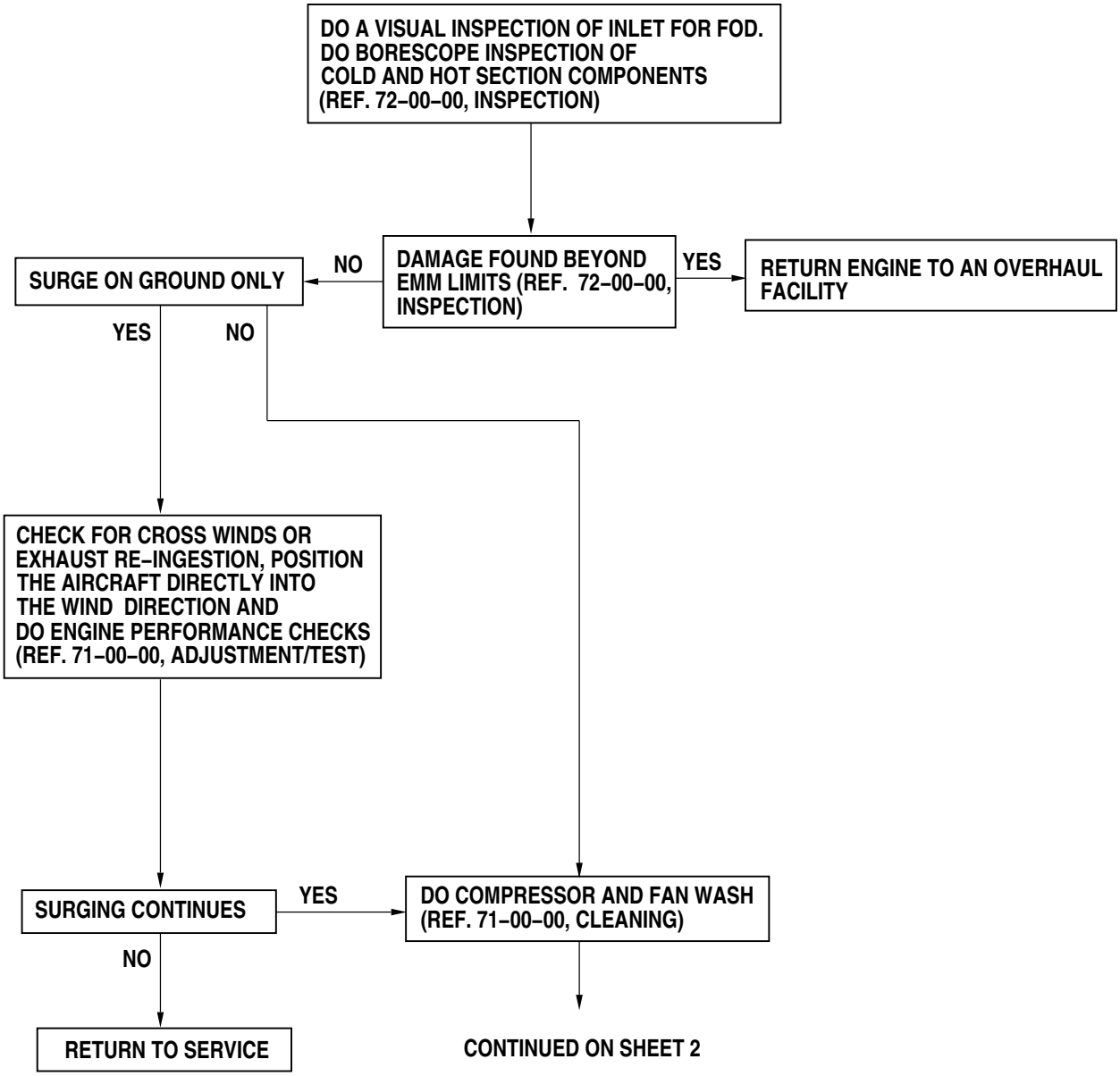
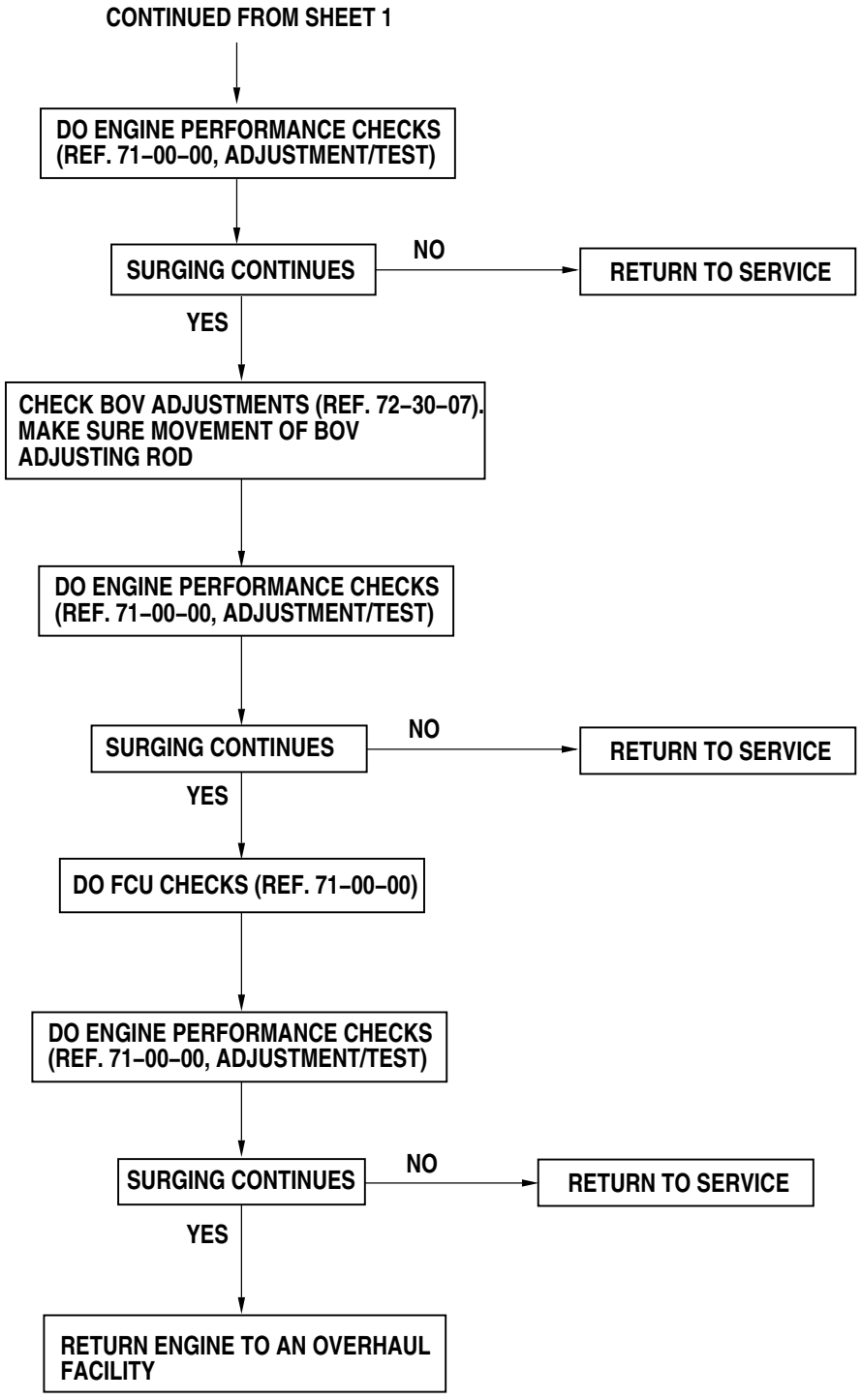
ENGINE SURGE


DO A VISUAL INSPECTION OF INLET FOR FOD.
DO BORESCOPE INSPECTION OF
COLD AND HOT SECTION COMPONENTS
(REF. 72–00–00, INSPECTION)
DAMAGE FOUND BEYOND EMM LIMITS (REF. 72–00–00, INSPECTION)
NO
YES
RETURN ENGINE TO AN OVERHAUL FACILITY
SURGE ON GROUND ONLY
YES
NO
CHECK FOR CROSS WINDS OR EXHAUST RE–INGESTION, POSITION THE AIRCRAFT DIRECTLY INTO THE WIND DIRECTION AND
DO ENGINE PERFORMANCE CHECKS
(REF. 71–00–00, ADJUSTMENT/TEST)
SURGING CONTINUES
YES
DO COMPRESSOR AND FAN WASH
(REF. 71–00–00, CLEANING)
NO
RETURN TO SERVICE
CONTINUED ON SHEET 2

C196146

Engine Surge
Figure 116 (Sheet 1 of 2)



C196147

Engine Surge
Figure 116 (Sheet 2)

P&WC Proprietary Information. Subject to the restriction on the title page.
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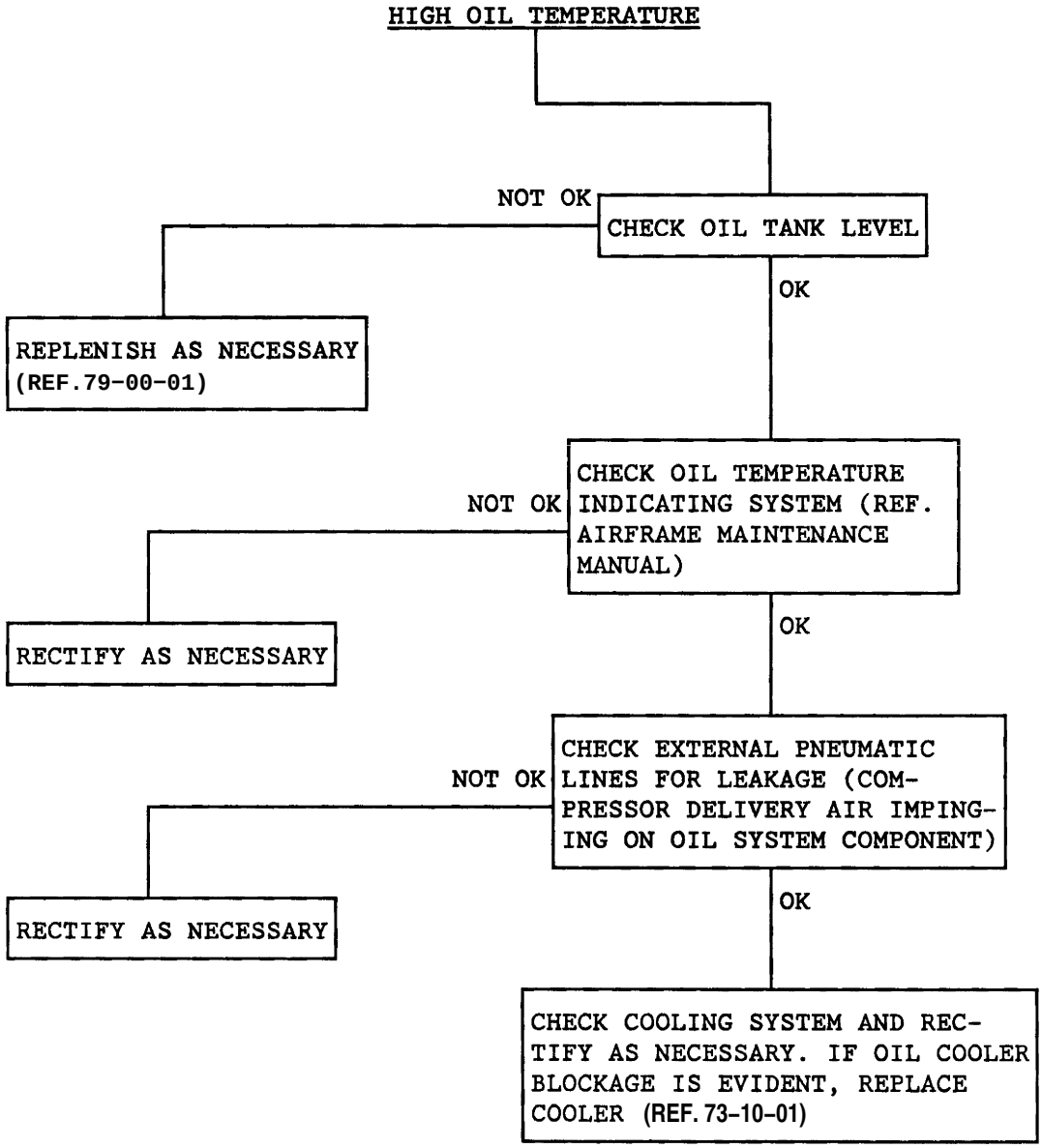
HIGH OIL TEMPERATURE
NOT OK
CHECK OIL TANK LEVEL
OK
REPLENISH AS NECESSARY (REF.79-00-01)
CHECK OIL TEMPERATURE INDICATING SYSTEM (REF. AIRFRAME MAINTENANCE MANUAL)
NOT OK
OK
RECTIFY AS NECESSARY
CHECK EXTERNAL PNEUMATIC LINES FOR LEAKAGE (COMPRESSOR DELIVERY AIR IMPINGING ON OIL SYSTEM COMPONENT)
NOT OK
OK
RECTIFY AS NECESSARY
CHECK COOLING SYSTEM AND RECTIFY AS NECESSARY. IF OIL COOLER BLOCKAGE IS EVIDENT, REPLACE COOLER (REF. 73-10-01)

C24550A

High Oil Temperature
Figure 117

P&WC Proprietary Information. Subject to the restriction on the title page.
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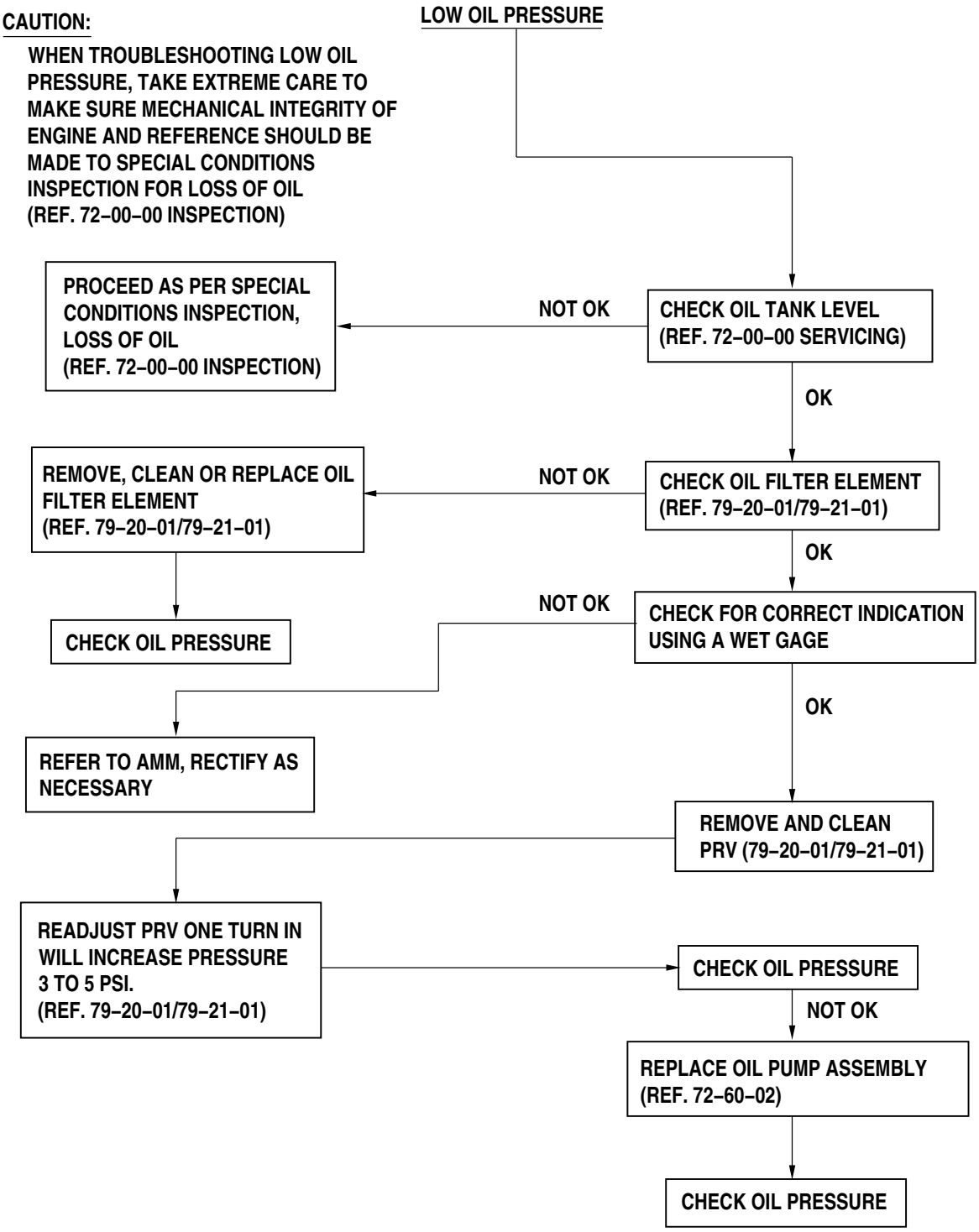
CAUTION:
WHEN TROUBLESHOOTING LOW OIL PRESSURE, TAKE EXTREME CARE TO MAKE SURE MECHANICAL INTEGRITY OF ENGINE AND REFERENCE SHOULD BE MADE TO SPECIAL CONDITIONS INSPECTION FOR LOSS OF OIL (REF. 72–00–00 INSPECTION)
LOW OIL PRESSURE
CHECK OIL TANK LEVEL (REF. 72–00–00 SERVICING)
NOT OK
PROCEED AS PER SPECIAL CONDITIONS INSPECTION, LOSS OF OIL (REF. 72–00–00 INSPECTION)
OK
CHECK OIL FILTER ELEMENT (REF. 79–20–01/79–21–01)
NOT OK
REMOVE, CLEAN OR REPLACE OIL FILTER ELEMENT (REF. 79–20–01/79–21–01)
OK
CHECK FOR CORRECT INDICATION USING A WET GAGE
NOT OK
CHECK OIL PRESSURE
OK
REFER TO AMM, RECTIFY AS NECESSARY
REMOVE AND CLEAN PRV (79–20–01/79–21–01)
READJUST PRV ONE TURN IN WILL INCREASE PRESSURE 3 TO 5 PSI. (REF. 79–20–01/79–21–01)
CHECK OIL PRESSURE
NOT OK
REPLACE OIL PUMP ASSEMBLY (REF. 72–60–02)
CHECK OIL PRESSURE

C192501

Low Oil Pressure
Figure 118

P&WC Proprietary Information. Subject to the restriction on the title page.
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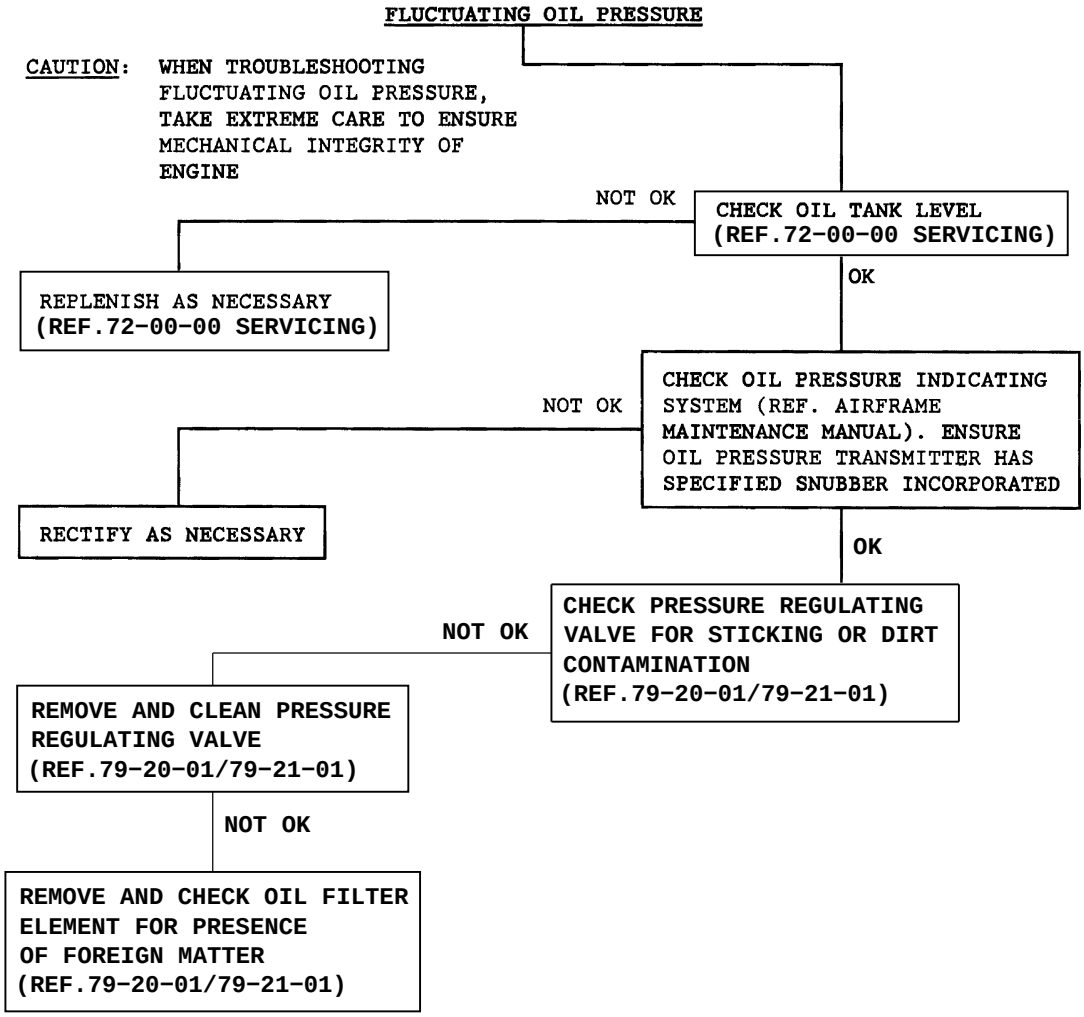
FLUCTUATING OIL PRESSURE
CAUTION: WHEN TROUBLESHOOTING FLUCTUATING OIL PRESSURE, TAKE EXTREME CARE TO ENSURE MECHANICAL INTEGRITY OF ENGINE
NOT OK
CHECK OIL TANK LEVEL (REF.72-00-00 SERVICING)
REPLENISH AS NECESSARY (REF.72-00-00 SERVICING)
OK
NOT OK
CHECK OIL PRESSURE INDICATING SYSTEM (REF. AIRFRAME MAINTENANCE MANUAL). ENSURE OIL PRESSURE TRANSMITTER HAS SPECIFIED SNUBBER INCORPORATED
RECTIFY AS NECESSARY
OK
NOT OK
CHECK PRESSURE REGULATING VALVE FOR STICKING OR DIRT CONTAMINATION (REF.79-20-01/79-21-01)
REMOVE AND CLEAN PRESSURE REGULATING VALVE (REF.79-20-01/79-21-01)
NOT OK
REMOVE AND CHECK OIL FILTER ELEMENT FOR PRESENCE OF FOREIGN MATTER (REF.79-20-01/79-21-01)

C24552C

Fluctuating Oil Pressure
Figure 119

P&WC Proprietary Information. Subject to the restriction on the title page.
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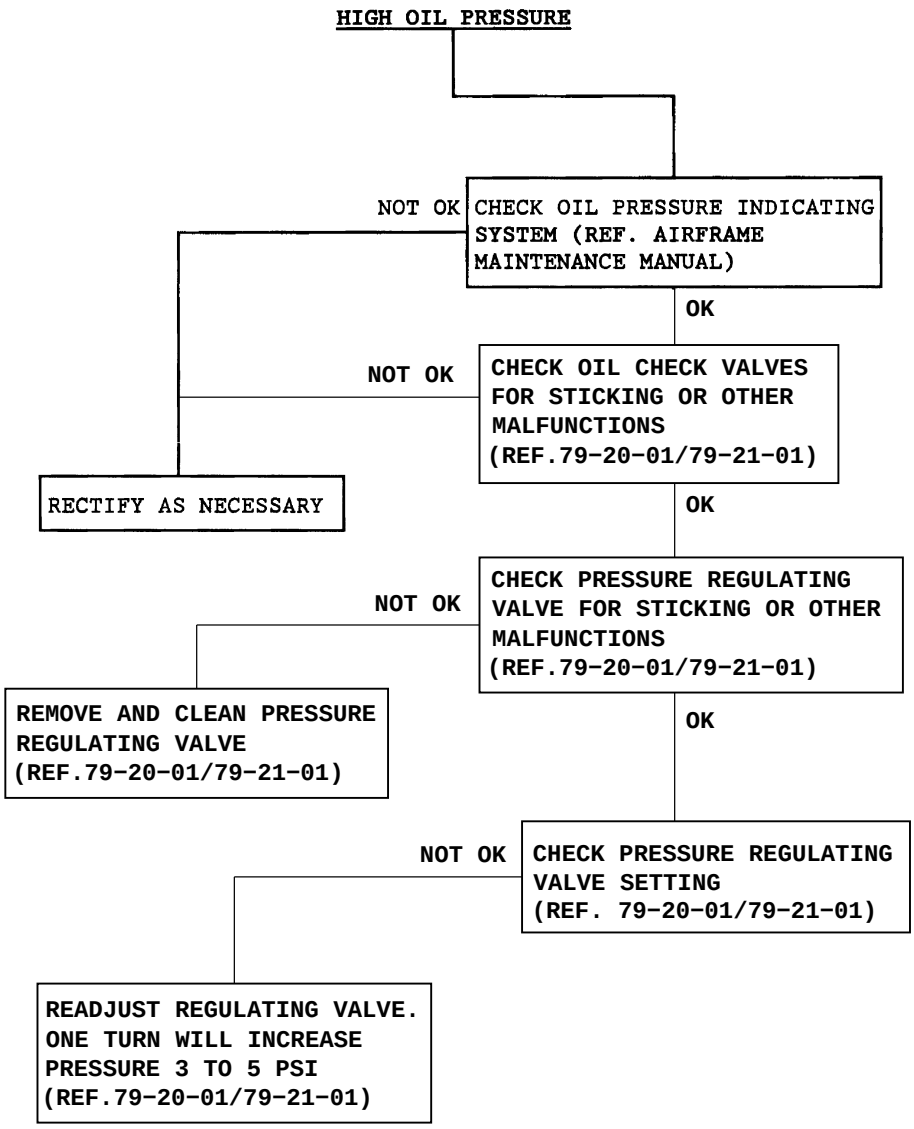
HIGH OIL PRESSURE
CHECK OIL PRESSURE INDICATING SYSTEM (REF. AIRFRAME MAINTENANCE MANUAL)
NOT OK
OK
CHECK OIL CHECK VALVES FOR STICKING OR OTHER MALFUNCTIONS (REF.79-20-01/79-21-01)
NOT OK
RECTIFY AS NECESSARY
OK
CHECK PRESSURE REGULATING VALVE FOR STICKING OR OTHER MALFUNCTIONS (REF.79-20-01/79-21-01)
NOT OK
REMOVE AND CLEAN PRESSURE REGULATING VALVE (REF.79-20-01/79-21-01)
OK
CHECK PRESSURE REGULATING VALVE SETTING (REF. 79-20-01/79-21-01)
NOT OK
READJUST REGULATING VALVE. ONE TURN WILL INCREASE PRESSURE 3 TO 5 PSI (REF.79-20-01/79-21-01)

C24553B

High Oil Pressure
Figure 120

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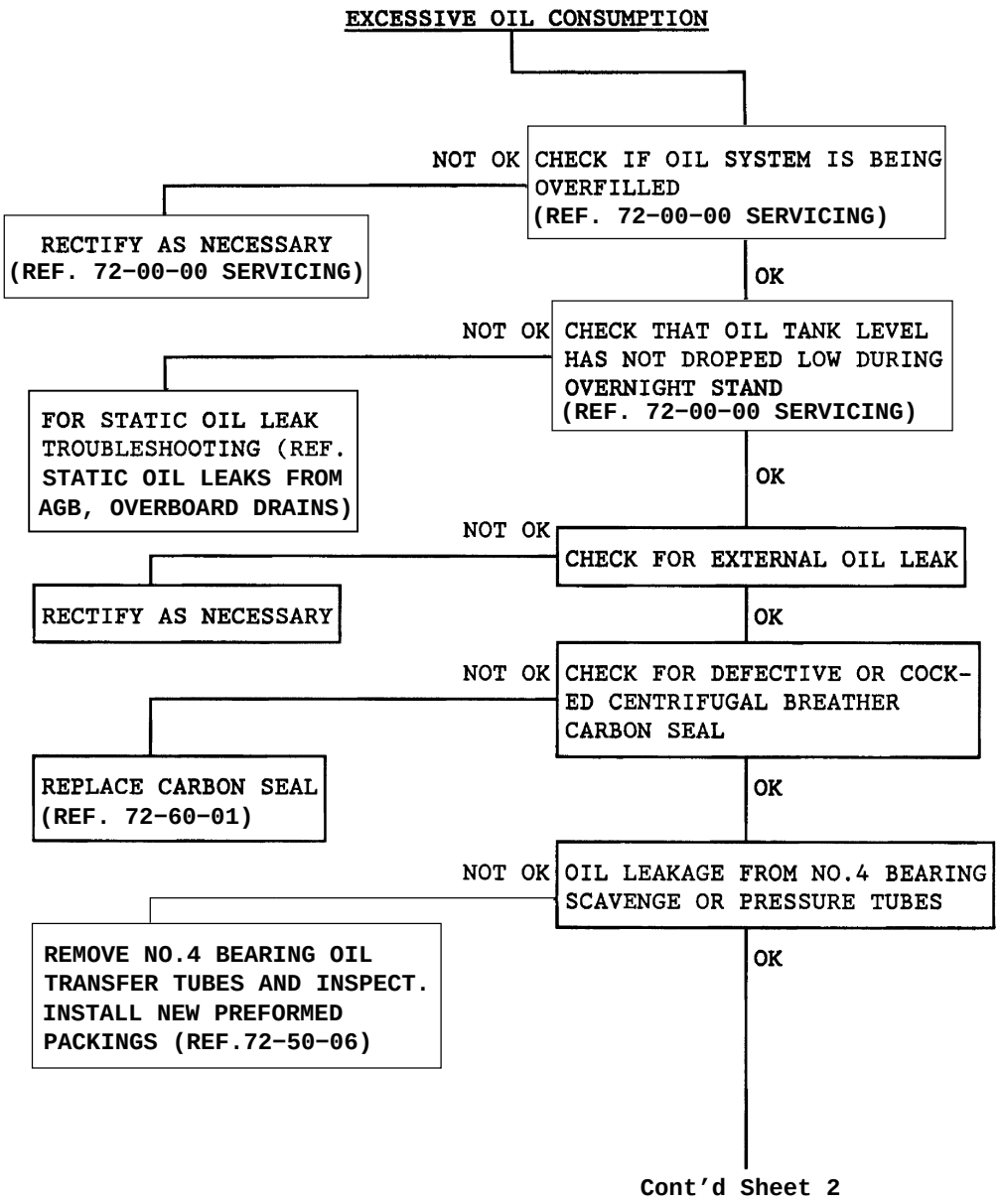
EXCESSIVE OIL CONSUMPTION
CHECK IF OIL SYSTEM IS BEING OVERFILLED (REF. 72-00-00 SERVICING)
NOT OK
RECTIFY AS NECESSARY (REF. 72-00-00 SERVICING)
OK
CHECK THAT OIL TANK LEVEL HAS NOT DROPPED LOW DURING OVERNIGHT STAND (REF. 72-00-00 SERVICING)
NOT OK
FOR STATIC OIL LEAK TROUBLESHOOTING (REF. STATIC OIL LEAKS FROM AGB, OVERBOARD DRAINS)
OK
CHECK FOR EXTERNAL OIL LEAK
NOT OK
RECTIFY AS NECESSARY
OK
CHECK FOR DEFECTIVE OR COCKED CENTRIFUGAL BREATHER CARBON SEAL
NOT OK
REPLACE CARBON SEAL (REF. 72-60-01)
OK
OIL LEAKAGE FROM NO.4 BEARING SCAVENGE OR PRESSURE TUBES
NOT OK
REMOVE NO.4 BEARING OIL TRANSFER TUBES AND INSPECT. INSTALL NEW PREFORMED PACKINGS (REF.72-50-06)
OK
Cont'd Sheet 2

C24554C

Excessive Oil Consumption
Figure 121 (Sheet 1 of 2)

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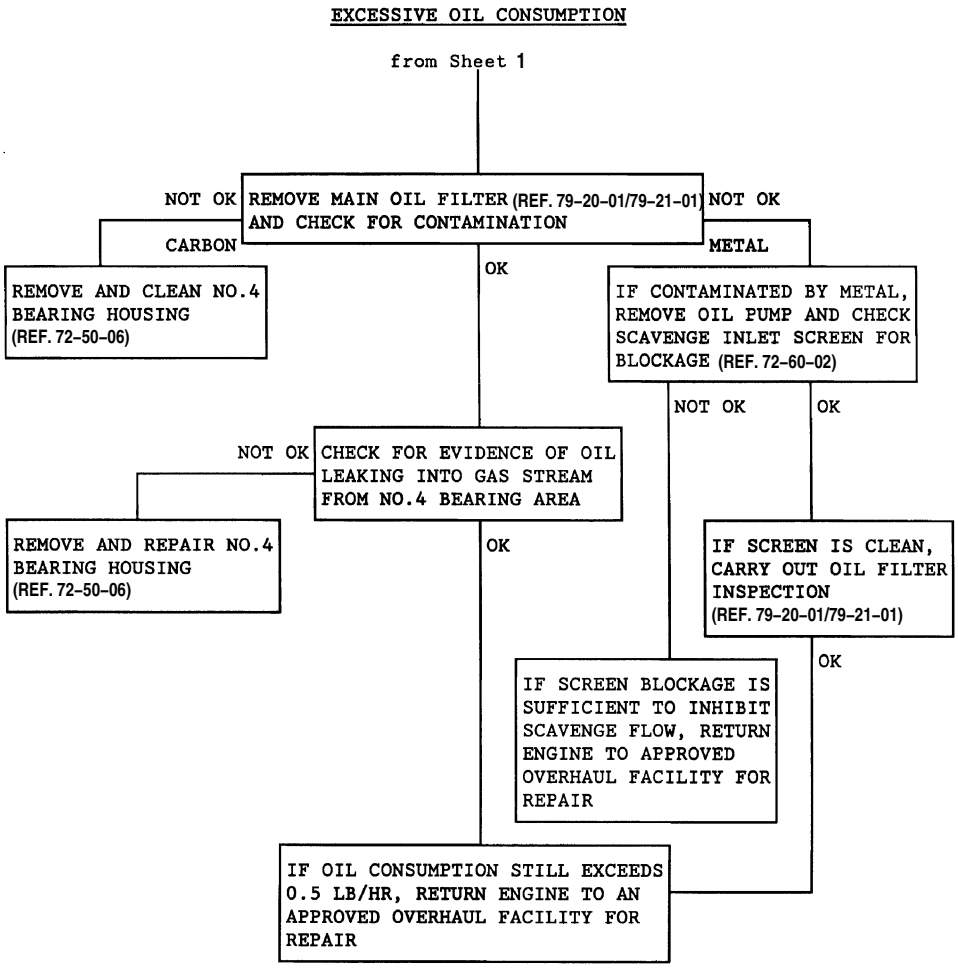
EXCESSIVE OIL CONSUMPTION
from Sheet 1
REMOVE MAIN OIL FILTER (REF. 79-20-01/79-21-01) AND CHECK FOR CONTAMINATION
NOT OK
CARBON
NOT OK
METAL
OK
REMOVE AND CLEAN NO.4 BEARING HOUSING (REF. 72-50-06)
IF CONTAMINATED BY METAL, REMOVE OIL PUMP AND CHECK SCAVENGE INLET SCREEN FOR BLOCKAGE (REF. 72-60-02)
NOT OK
OK
NOT OK
CHECK FOR EVIDENCE OF OIL LEAKING INTO GAS STREAM FROM NO.4 BEARING AREA
REMOVE AND REPAIR NO.4 BEARING HOUSING (REF. 72-50-06)
OK
IF SCREEN IS CLEAN, CARRY OUT OIL FILTER INSPECTION (REF. 79-20-01/79-21-01)
OK
IF SCREEN BLOCKAGE IS SUFFICIENT TO INHIBIT SCAVENGE FLOW, RETURN ENGINE TO APPROVED OVERHAUL FACILITY FOR REPAIR
IF OIL CONSUMPTION STILL EXCEEDS 0.5 LB/HR, RETURN ENGINE TO AN APPROVED OVERHAUL FACILITY FOR REPAIR

C24555B

Excessive Oil Consumption
Figure 121 (Sheet 2)

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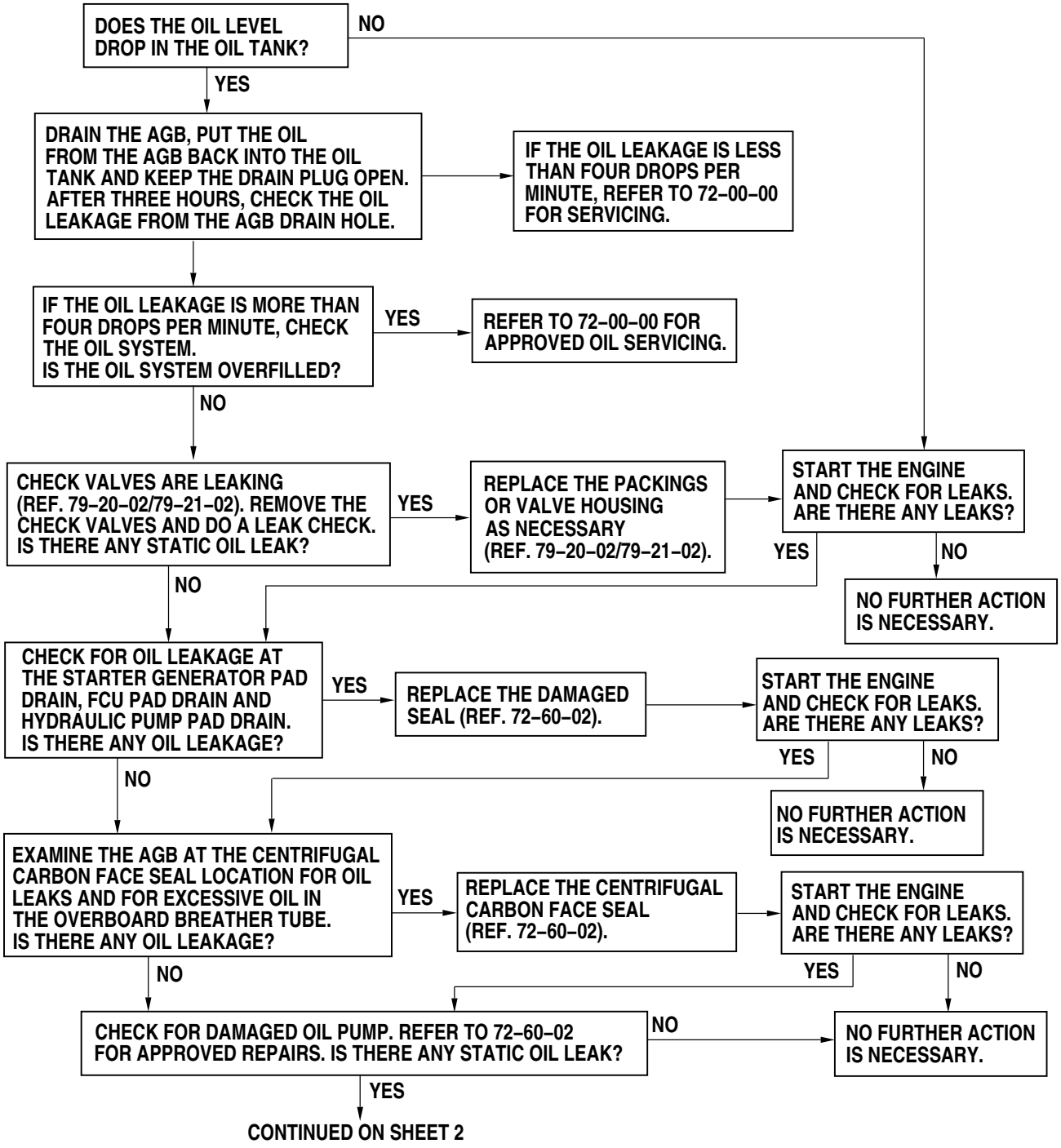
OIL LEAKS FROM AGB OVERBOARD DRAINS


DOES THE OIL LEVEL DROP IN THE OIL TANK?
NO
YES
DRAIN THE AGB, PUT THE OIL FROM THE AGB BACK INTO THE OIL TANK AND KEEP THE DRAIN PLUG OPEN. AFTER THREE HOURS, CHECK THE OIL LEAKAGE FROM THE AGB DRAIN HOLE.
IF THE OIL LEAKAGE IS LESS THAN FOUR DROPS PER MINUTE, REFER TO 72–00–00 FOR SERVICING.
IF THE OIL LEAKAGE IS MORE THAN FOUR DROPS PER MINUTE, CHECK THE OIL SYSTEM. IS THE OIL SYSTEM OVERFILLED?
YES
REFER TO 72–00–00 FOR APPROVED OIL SERVICING.
NO
CHECK VALVES ARE LEAKING (REF. 79–20–02/79–21–02). REMOVE THE CHECK VALVES AND DO A LEAK CHECK. IS THERE ANY STATIC OIL LEAK?
YES
REPLACE THE PACKINGS OR VALVE HOUSING AS NECESSARY (REF. 79–20–02/79–21–02).
START THE ENGINE AND CHECK FOR LEAKS. ARE THERE ANY LEAKS?
YES
NO
NO FURTHER ACTION IS NECESSARY.
NO
CHECK FOR OIL LEAKAGE AT THE STARTER GENERATOR PAD DRAIN, FCU PAD DRAIN AND HYDRAULIC PUMP PAD DRAIN. IS THERE ANY OIL LEAKAGE?
YES
REPLACE THE DAMAGED SEAL (REF. 72–60–02).
START THE ENGINE AND CHECK FOR LEAKS. ARE THERE ANY LEAKS?
YES
NO
NO FURTHER ACTION IS NECESSARY.
NO
EXAMINE THE AGB AT THE CENTRIFUGAL CARBON FACE SEAL LOCATION FOR OIL LEAKS AND FOR EXCESSIVE OIL IN THE OVERBOARD BREATHER TUBE. IS THERE ANY OIL LEAKAGE?
YES
REPLACE THE CENTRIFUGAL CARBON FACE SEAL (REF. 72–60–02).
START THE ENGINE AND CHECK FOR LEAKS. ARE THERE ANY LEAKS?
YES
NO
NO
CHECK FOR DAMAGED OIL PUMP. REFER TO 72–60–02 FOR APPROVED REPAIRS. IS THERE ANY STATIC OIL LEAK?
NO
NO FURTHER ACTION IS NECESSARY.
YES
CONTINUED ON SHEET 2

C231807

Oil Leaks From AGB Overboard Drains
Figure 122 (Sheet 1 of 2)

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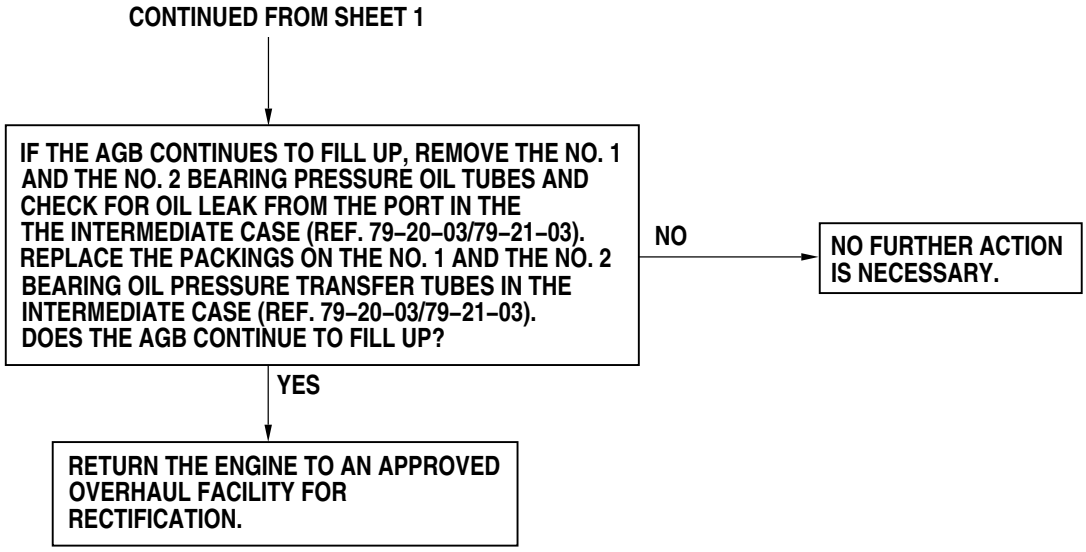
CONTINUED FROM SHEET 1
IF THE AGB CONTINUES TO FILL UP, REMOVE THE NO. 1 AND THE NO. 2 BEARING PRESSURE OIL TUBES AND CHECK FOR OIL LEAK FROM THE PORT IN THE THE INTERMEDIATE CASE (REF. 79–20–03/79–21–03). REPLACE THE PACKINGS ON THE NO. 1 AND THE NO. 2 BEARING OIL PRESSURE TRANSFER TUBES IN THE INTERMEDIATE CASE (REF. 79–20–03/79–21–03). DOES THE AGB CONTINUE TO FILL UP?
NO
NO FURTHER ACTION IS NECESSARY.
YES
RETURN THE ENGINE TO AN APPROVED OVERHAUL FACILITY FOR RECTIFICATION.

C231809

Oil Leaks From AGB Overboard Drains
Figure 122 (Sheet 2)

P&WC Proprietary Information. Subject to the restriction on the title page.
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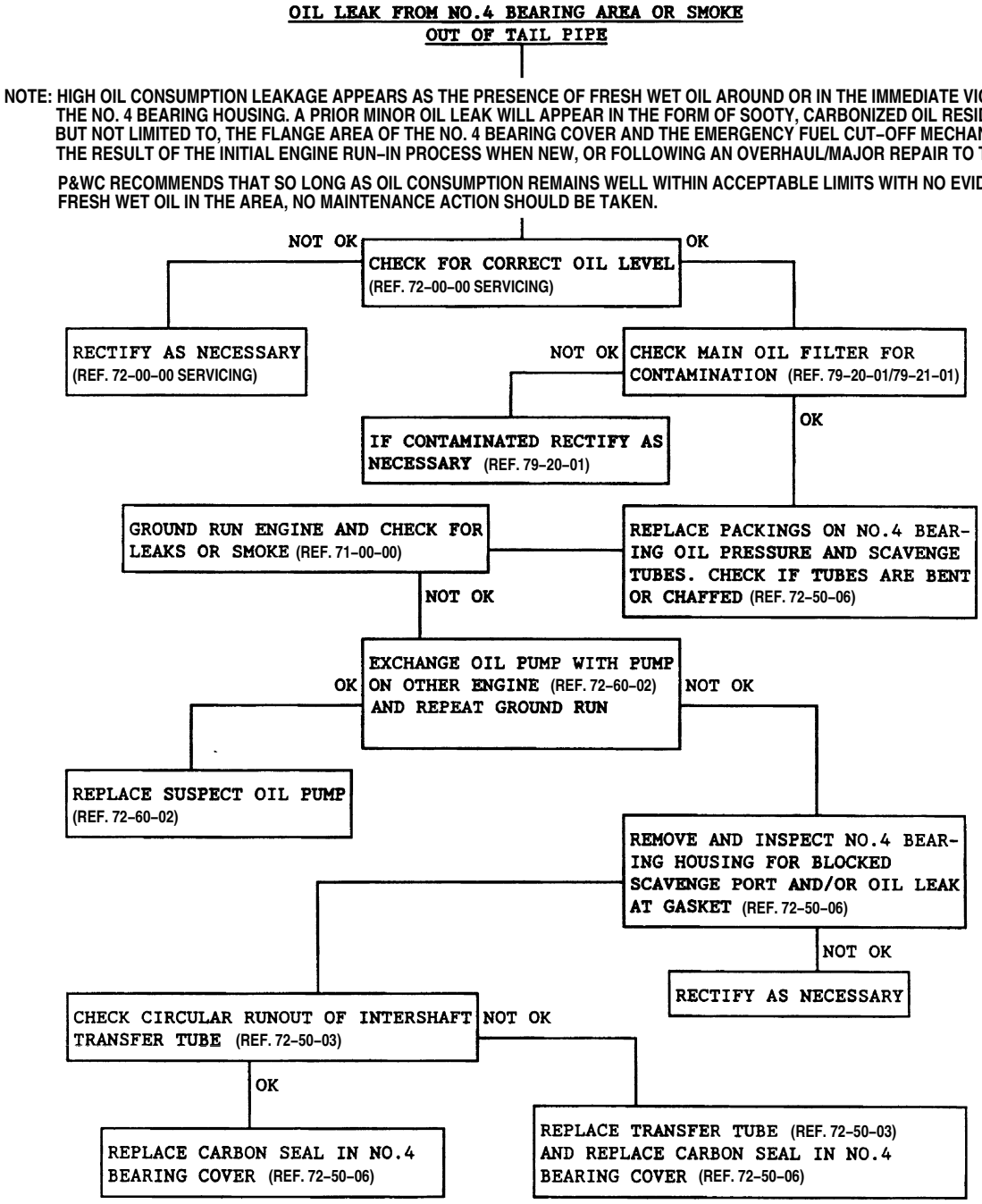
OIL LEAK FROM NO.4 BEARING AREA OR SMOKE OUT OF TAIL PIPE
NOTE: HIGH OIL CONSUMPTION LEAKAGE APPEARS AS THE PRESENCE OF FRESH WET OIL AROUND OR IN THE IMMEDIATE VICINITY OF THE NO. 4 BEARING HOUSING. A PRIOR MINOR OIL LEAK WILL APPEAR IN THE FORM OF SOOTY, CARBONIZED OIL RESIDUE AROUND, BUT NOT LIMITED TO, THE FLANGE AREA OF THE NO. 4 BEARING COVER AND THE EMERGENCY FUEL CUT-OFF MECHANISM. THIS IS THE RESULT OF THE INITIAL ENGINE RUN-IN PROCESS WHEN NEW, OR FOLLOWING AN OVERHAUL/MAJOR REPAIR TO THE AREA.
P&WC RECOMMENDS THAT SO LONG AS OIL CONSUMPTION REMAINS WELL WITHIN ACCEPTABLE LIMITS WITH NO EVIDENCE OF FRESH WET OIL IN THE AREA, NO MAINTENANCE ACTION SHOULD BE TAKEN.
CHECK FOR CORRECT OIL LEVEL (REF. 72-00-00 SERVICING)
NOT OK
OK
RECTIFY AS NECESSARY (REF. 72-00-00 SERVICING)
CHECK MAIN OIL FILTER FOR CONTAMINATION (REF. 79-20-01/79-21-01)
NOT OK
OK
IF CONTAMINATED RECTIFY AS NECESSARY (REF. 79-20-01)
GROUND RUN ENGINE AND CHECK FOR LEAKS OR SMOKE (REF. 71-00-00)
REPLACE PACKINGS ON NO.4 BEARING OIL PRESSURE AND SCAVENGE TUBES. CHECK IF TUBES ARE BENT OR CHAFFED (REF. 72-50-06)
NOT OK
EXCHANGE OIL PUMP WITH PUMP ON OTHER ENGINE (REF. 72-60-02) AND REPEAT GROUND RUN
OK
NOT OK
REPLACE SUSPECT OIL PUMP (REF. 72-60-02)
REMOVE AND INSPECT NO.4 BEARING HOUSING FOR BLOCKED SCAVENGE PORT AND/OR OIL LEAK AT GASKET (REF. 72-50-06)
NOT OK
RECTIFY AS NECESSARY
CHECK CIRCULAR RUNOUT OF INTERSHAFT TRANSFER TUBE (REF. 72-50-03)
NOT OK
OK
REPLACE CARBON SEAL IN NO.4 BEARING COVER (REF. 72-50-06)
REPLACE TRANSFER TUBE (REF. 72-50-03) AND REPLACE CARBON SEAL IN NO.4 BEARING COVER (REF. 72-50-06)

C145962

Oil Leak From No. 4 Bearing Area Or Smoke Out Of Tail Pipe
Figure 123

P&WC Proprietary Information. Subject to the restriction on the title page.
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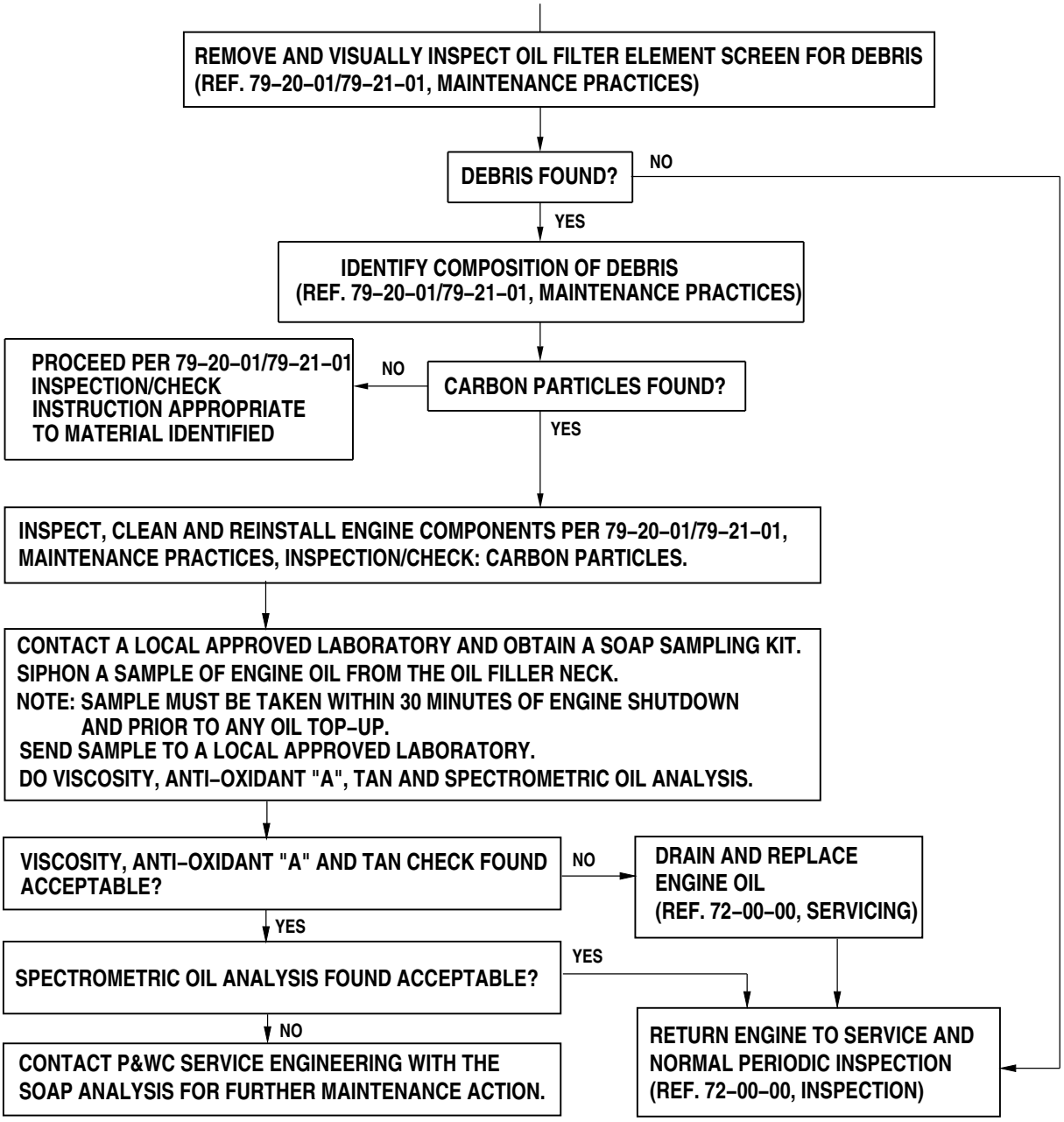
DISCOLORED ENGINE OIL/PRESENCE OF CARBON PARTICLES IN ENGINE OIL

NOTE: It is normal for turbine oil to acquire an amber or light brown color after 50 to 100 hours of operation. In some instances, the oil may appear very dark. This accelerated discoloration of the oil is not itself a cause for concern, since the lubricating properties are not affected. The darkening is a result of the chemical activation of anti–oxidant additives in the oil. Providing the oil contains no particulate carbon material, no further action is required.


REMOVE AND VISUALLY INSPECT OIL FILTER ELEMENT SCREEN FOR DEBRIS (REF. 79–20–01/79–21–01, MAINTENANCE PRACTICES)
DEBRIS FOUND?
NO
YES
IDENTIFY COMPOSITION OF DEBRIS (REF. 79–20–01/79–21–01, MAINTENANCE PRACTICES)
CARBON PARTICLES FOUND?
NO
PROCEED PER 79–20–01/79–21–01 INSPECTION/CHECK INSTRUCTION APPROPRIATE TO MATERIAL IDENTIFIED
YES
INSPECT, CLEAN AND REINSTALL ENGINE COMPONENTS PER 79–20–01/79–21–01, MAINTENANCE PRACTICES, INSPECTION/CHECK: CARBON PARTICLES.
CONTACT A LOCAL APPROVED LABORATORY AND OBTAIN A SOAP SAMPLING KIT.
SIPHON A SAMPLE OF ENGINE OIL FROM THE OIL FILLER NECK.
NOTE: SAMPLE MUST BE TAKEN WITHIN 30 MINUTES OF ENGINE SHUTDOWN AND PRIOR TO ANY OIL TOP–UP.
SEND SAMPLE TO A LOCAL APPROVED LABORATORY.
DO VISCOSITY, ANTI–OXIDANT "A", TAN AND SPECTROMETRIC OIL ANALYSIS.
VISCOSITY, ANTI–OXIDANT "A" AND TAN CHECK FOUND ACCEPTABLE?
NO
DRAIN AND REPLACE ENGINE OIL (REF. 72–00–00, SERVICING)
YES
SPECTROMETRIC OIL ANALYSIS FOUND ACCEPTABLE?
YES
NO
CONTACT P&WC SERVICE ENGINEERING WITH THE SOAP ANALYSIS FOR FURTHER MAINTENANCE ACTION.
RETURN ENGINE TO SERVICE AND NORMAL PERIODIC INSPECTION (REF. 72–00–00, INSPECTION)

C24558E

Discolored Oil
Figure 124

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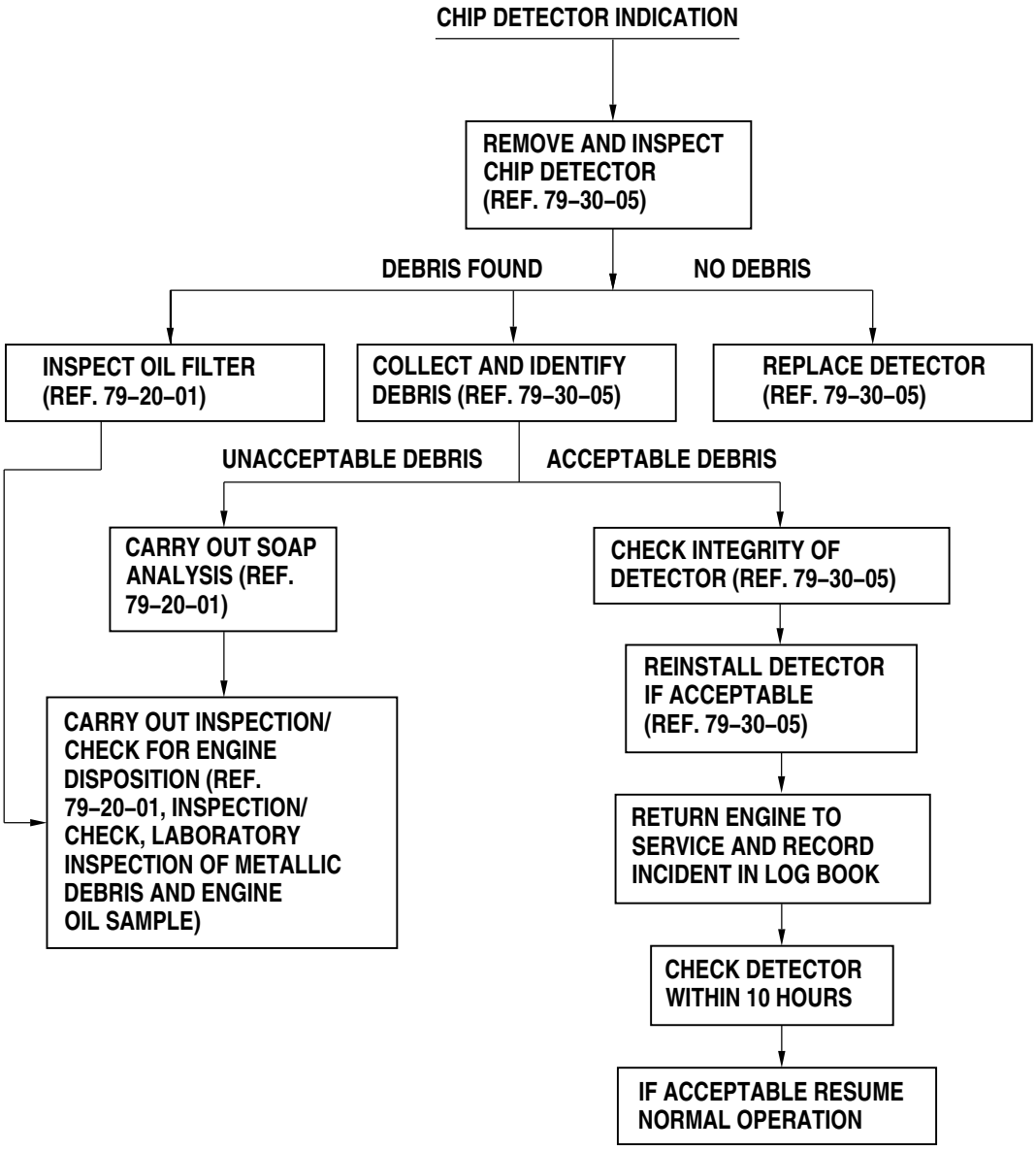
CHIP DETECTOR INDICATION
REMOVE AND INSPECT CHIP DETECTOR (REF. 79–30–05)
DEBRIS FOUND
NO DEBRIS
INSPECT OIL FILTER (REF. 79–20–01)
COLLECT AND IDENTIFY DEBRIS (REF. 79–30–05)
REPLACE DETECTOR (REF. 79–30–05)
UNACCEPTABLE DEBRIS
ACCEPTABLE DEBRIS
CARRY OUT SOAP ANALYSIS (REF. 79–20–01)
CHECK INTEGRITY OF DETECTOR (REF. 79–30–05)
REINSTALL DETECTOR IF ACCEPTABLE (REF. 79–30–05)
CARRY OUT INSPECTION/ CHECK FOR ENGINE DISPOSITION (REF. 79–20–01, INSPECTION/ CHECK, LABORATORY INSPECTION OF METALLIC DEBRIS AND ENGINE OIL SAMPLE)
RETURN ENGINE TO SERVICE AND RECORD INCIDENT IN LOG BOOK
CHECK DETECTOR WITHIN 10 HOURS
IF ACCEPTABLE RESUME NORMAL OPERATION

JT15D-5 C185334

Chip Detector Indication
Figure 125 (Sheet 1 of 2)

P&WC Proprietary Information. Subject to the restriction on the title page.
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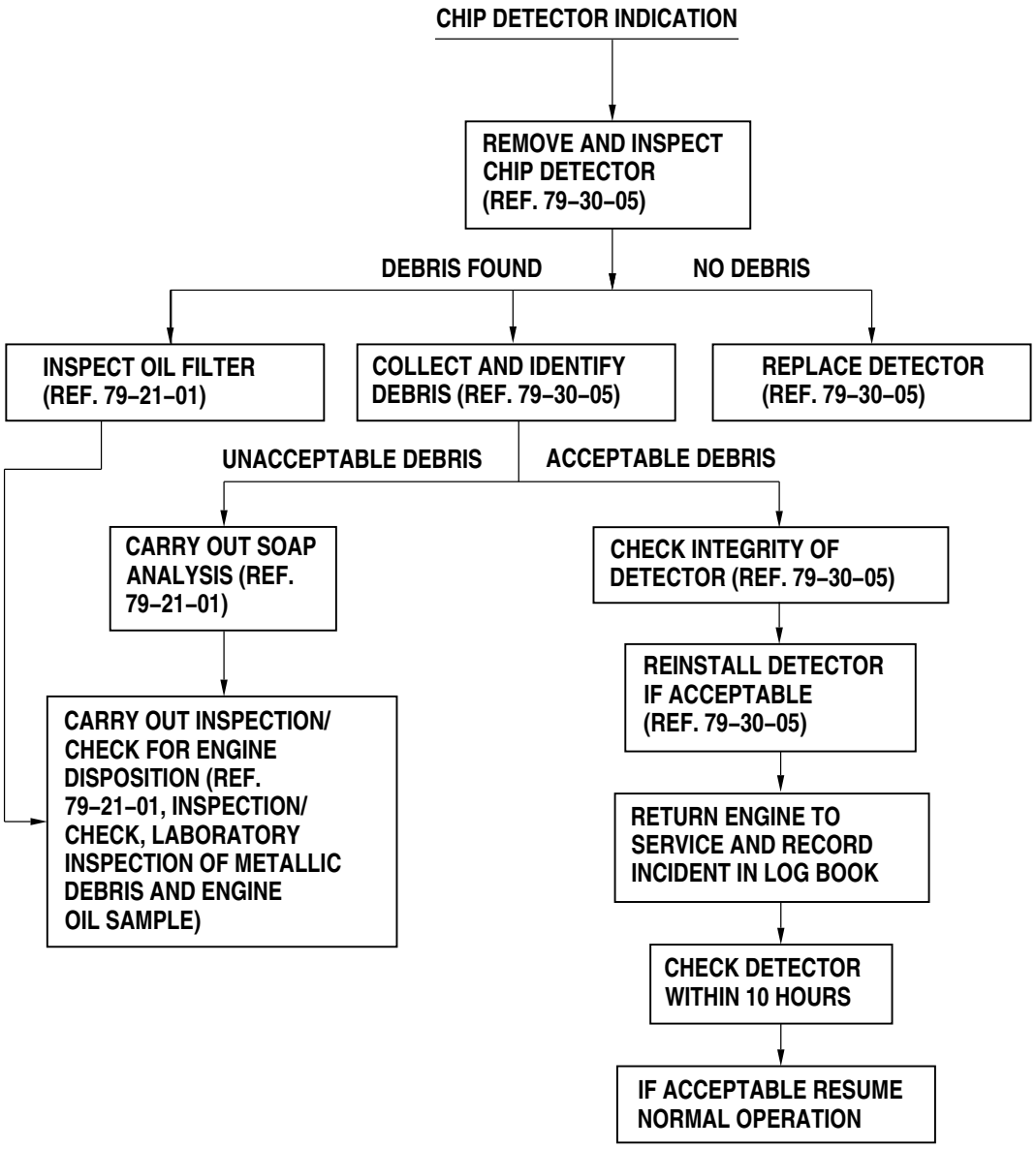
CHIP DETECTOR INDICATION
REMOVE AND INSPECT CHIP DETECTOR (REF. 79–30–05)
DEBRIS FOUND
NO DEBRIS
INSPECT OIL FILTER (REF. 79–21–01)
COLLECT AND IDENTIFY DEBRIS (REF. 79–30–05)
REPLACE DETECTOR (REF. 79–30–05)
UNACCEPTABLE DEBRIS
ACCEPTABLE DEBRIS
CARRY OUT SOAP ANALYSIS (REF. 79–21–01)
CHECK INTEGRITY OF DETECTOR (REF. 79–30–05)
REINSTALL DETECTOR IF ACCEPTABLE (REF. 79–30–05)
CARRY OUT INSPECTION/ CHECK FOR ENGINE DISPOSITION (REF. 79–21–01, INSPECTION/ CHECK, LABORATORY INSPECTION OF METALLIC DEBRIS AND ENGINE OIL SAMPLE)
RETURN ENGINE TO SERVICE AND RECORD INCIDENT IN LOG BOOK
CHECK DETECTOR WITHIN 10 HOURS
IF ACCEPTABLE RESUME NORMAL OPERATION

JT15D-5R C185335

Chip Detector Indication
Figure 125 (Sheet 2)

P&WC Proprietary Information. Subject to the restriction on the title page.
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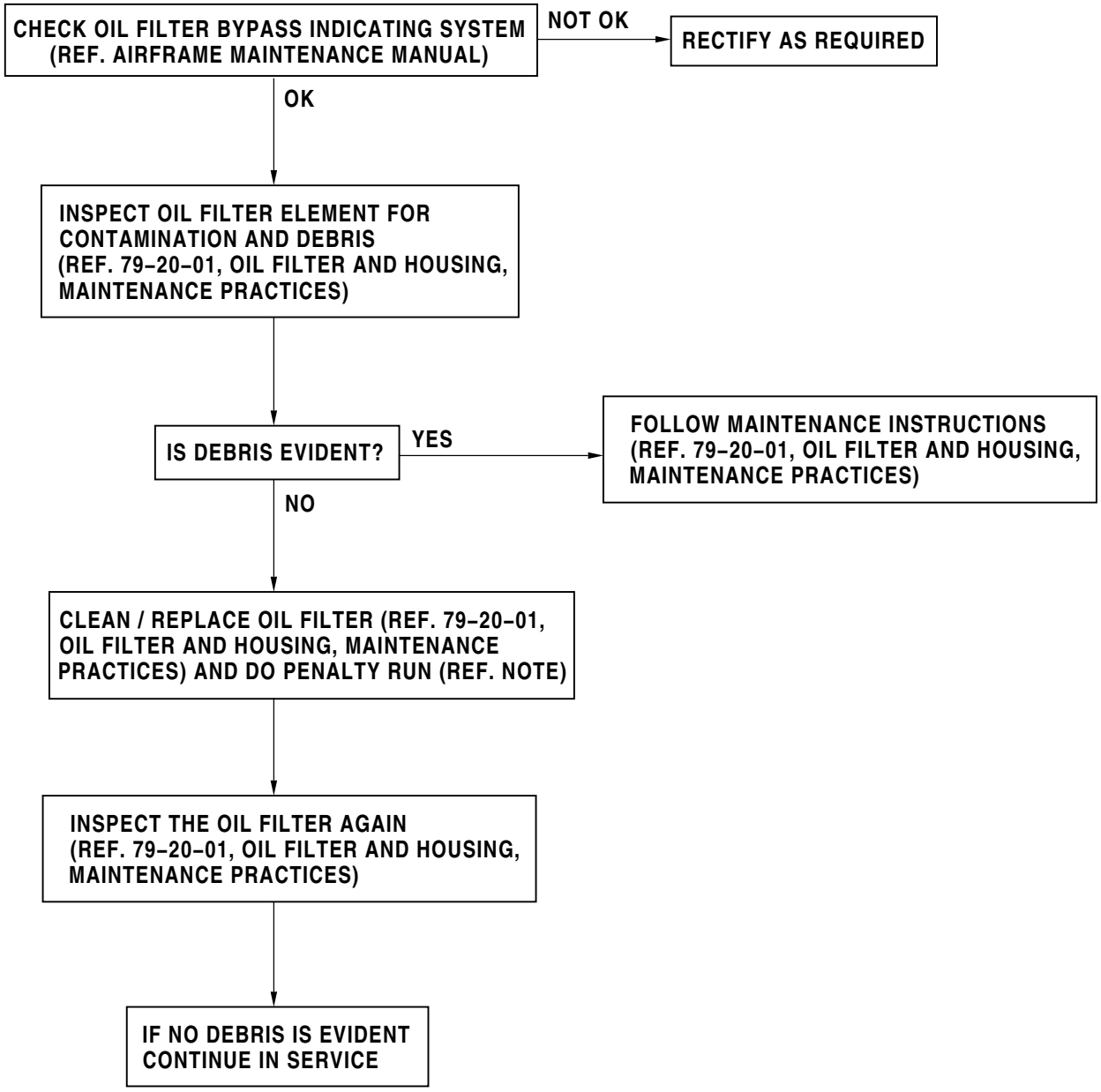
OIL FILTER BYPASS INDICATION

NOTE:

ONE HOUR GROUND RUN CONSISTS OF THREE CYCLES OF EACH 20 MINUTES. EACH CYCLE CONSISTS OF 10 MINUTES AT IDLE SPEED AND 10 MINUTES AT 80% OF MAXIMUM N1 SPEED.


CHECK OIL FILTER BYPASS INDICATING SYSTEM (REF. AIRFRAME MAINTENANCE MANUAL)
NOT OK
RECTIFY AS REQUIRED
OK
INSPECT OIL FILTER ELEMENT FOR CONTAMINATION AND DEBRIS (REF. 79–20–01, OIL FILTER AND HOUSING, MAINTENANCE PRACTICES)
IS DEBRIS EVIDENT?
YES
FOLLOW MAINTENANCE INSTRUCTIONS (REF. 79–20–01, OIL FILTER AND HOUSING, MAINTENANCE PRACTICES)
NO
CLEAN / REPLACE OIL FILTER (REF. 79–20–01, OIL FILTER AND HOUSING, MAINTENANCE PRACTICES) AND DO PENALTY RUN (REF. NOTE)
INSPECT THE OIL FILTER AGAIN (REF. 79–20–01, OIL FILTER AND HOUSING, MAINTENANCE PRACTICES)
IF NO DEBRIS IS EVIDENT CONTINUE IN SERVICE

JT15D-5 C201440

Oil Filter Bypass Indication
Figure 126 (Sheet 1 of 2)

P&WC Proprietary Information. Subject to the restriction on the title page.
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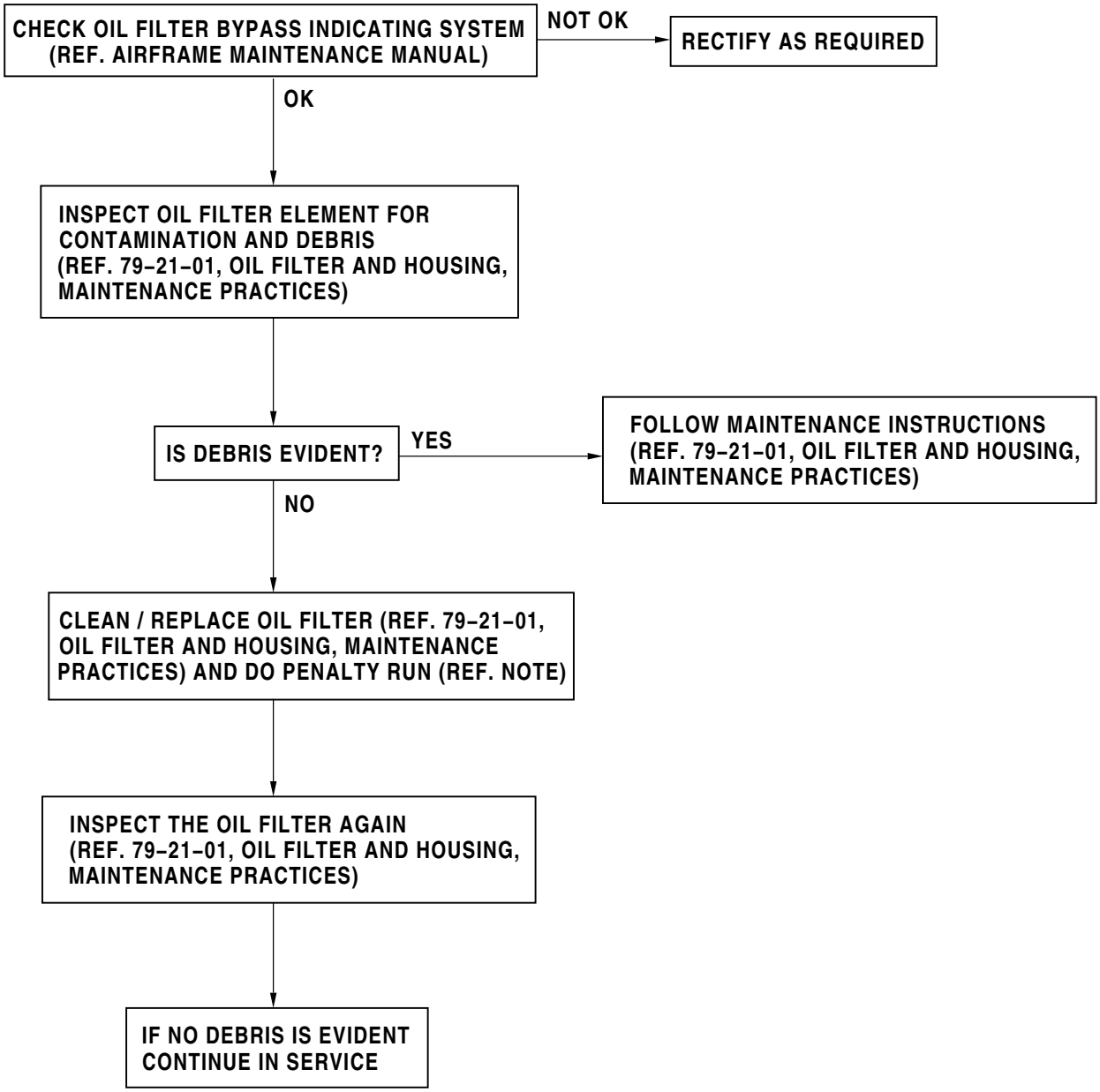
OIL FILTER BYPASS INDICATION

NOTE:

ONE HOUR GROUND RUN CONSISTS OF THREE CYCLES OF EACH 20 MINUTES. EACH CYCLE CONSISTS OF 10 MINUTES AT IDLE SPEED AND 10 MINUTES AT 80% OF MAXIMUM N1 SPEED.


CHECK OIL FILTER BYPASS INDICATING SYSTEM (REF. AIRFRAME MAINTENANCE MANUAL)
NOT OK
RECTIFY AS REQUIRED
OK
INSPECT OIL FILTER ELEMENT FOR CONTAMINATION AND DEBRIS (REF. 79–21–01, OIL FILTER AND HOUSING, MAINTENANCE PRACTICES)
IS DEBRIS EVIDENT?
YES
FOLLOW MAINTENANCE INSTRUCTIONS (REF. 79–21–01, OIL FILTER AND HOUSING, MAINTENANCE PRACTICES)
NO
CLEAN / REPLACE OIL FILTER (REF. 79–21–01, OIL FILTER AND HOUSING, MAINTENANCE PRACTICES) AND DO PENALTY RUN (REF. NOTE)
INSPECT THE OIL FILTER AGAIN (REF. 79–21–01, OIL FILTER AND HOUSING, MAINTENANCE PRACTICES)
IF NO DEBRIS IS EVIDENT CONTINUE IN SERVICE

JT15D-5R C201480

Oil Filter Bypass Indication
Figure 126 (Sheet 2)

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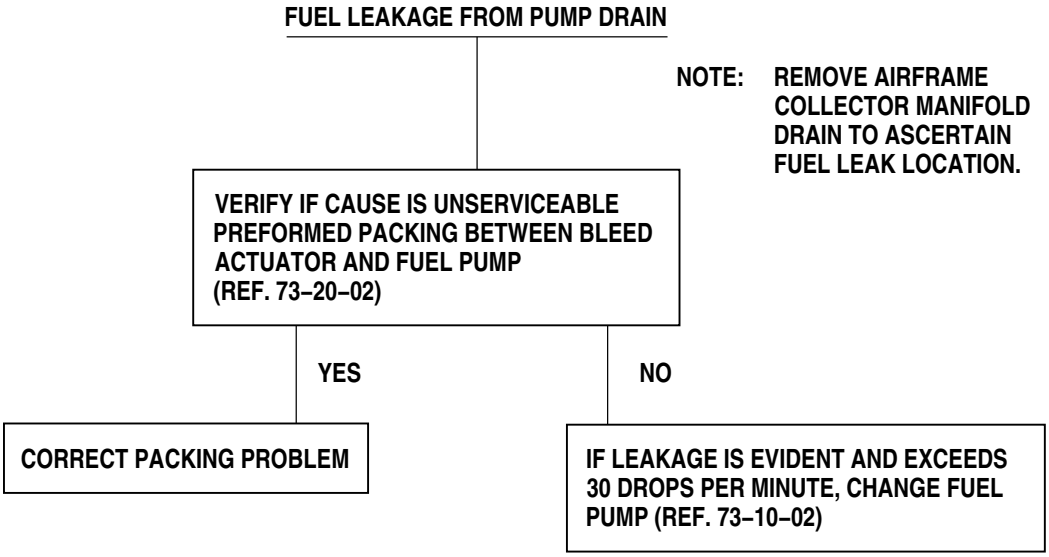
FUEL LEAKAGE FROM PUMP DRAIN
NOTE: REMOVE AIRFRAME COLLECTOR MANIFOLD DRAIN TO ASCERTAIN FUEL LEAK LOCATION.
VERIFY IF CAUSE IS UNSERVICEABLE PREFORMED PACKING BETWEEN BLEED ACTUATOR AND FUEL PUMP (REF. 73–20–02)
YES
NO
CORRECT PACKING PROBLEM
IF LEAKAGE IS EVIDENT AND EXCEEDS 30 DROPS PER MINUTE, CHANGE FUEL PUMP (REF. 73–10–02)

C24559A

Fuel Leakage From Pump Drain
Figure 127

P&WC Proprietary Information. Subject to the restriction on the title page.
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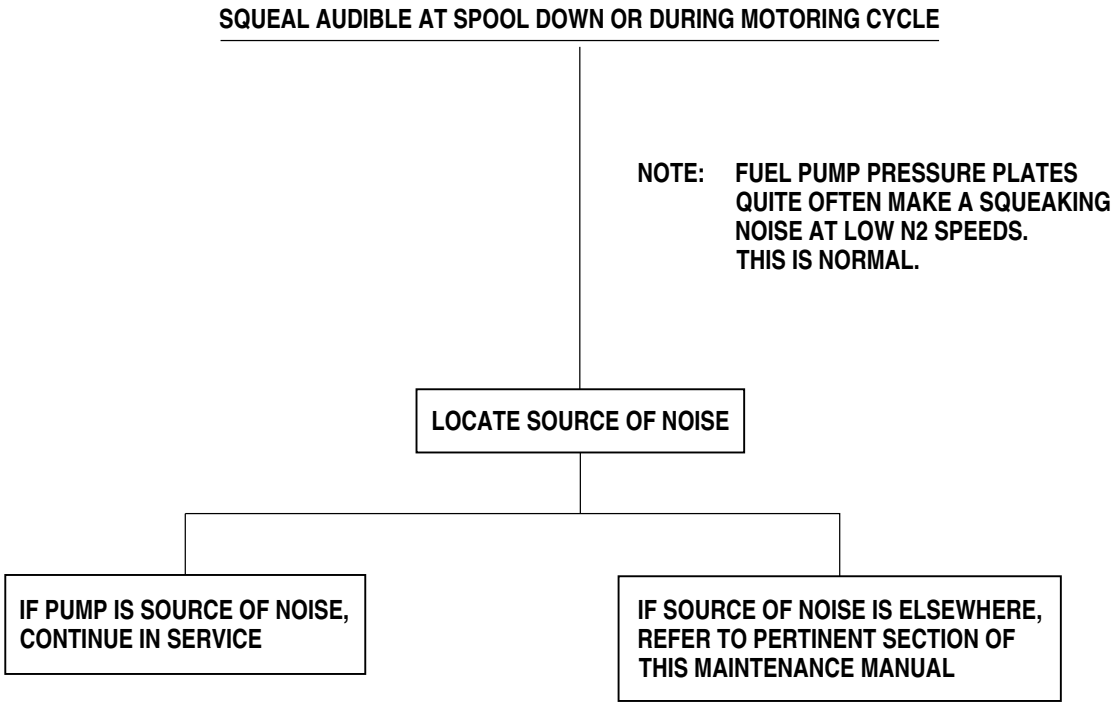
SQUEAL AUDIBLE AT SPOOL DOWN OR DURING MOTORING CYCLE
NOTE: FUEL PUMP PRESSURE PLATES QUITE OFTEN MAKE A SQUEAKING NOISE AT LOW N2 SPEEDS. THIS IS NORMAL.
LOCATE SOURCE OF NOISE
IF PUMP IS SOURCE OF NOISE, CONTINUE IN SERVICE
IF SOURCE OF NOISE IS ELSEWHERE, REFER TO PERTINENT SECTION OF THIS MAINTENANCE MANUAL

C24560

Squeal Audible At Spool Down Or During Motoring Cycle
Figure 128

P&WC Proprietary Information. Subject to the restriction on the title page.
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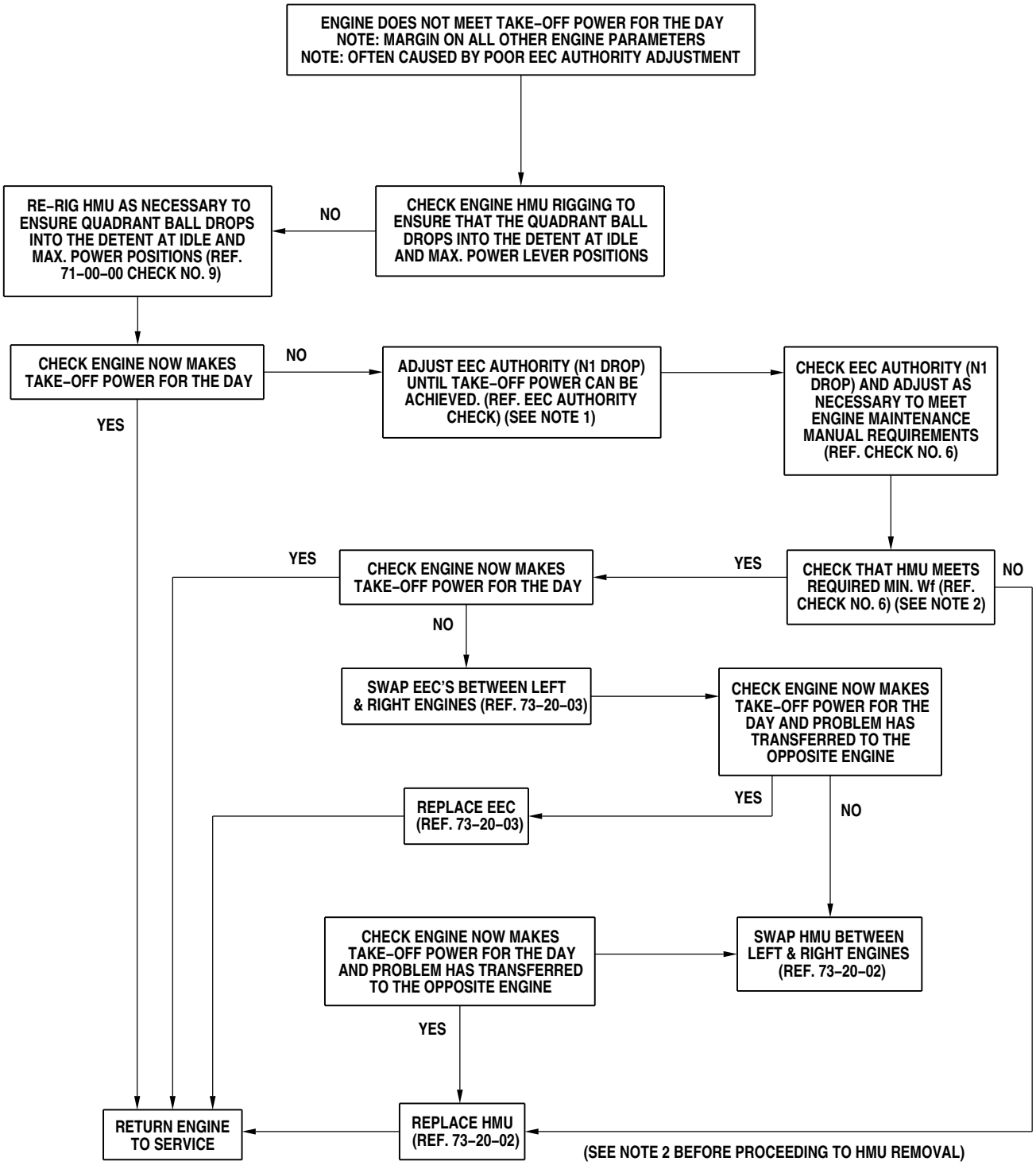

ENGINE DOES NOT MEET TAKE–OFF POWER FOR THE DAY
NOTE: MARGIN ON ALL OTHER ENGINE PARAMETERS
NOTE: OFTEN CAUSED BY POOR EEC AUTHORITY ADJUSTMENT
CHECK ENGINE HMU RIGGING TO ENSURE THAT THE QUADRANT BALL DROPS INTO THE DETENT AT IDLE AND MAX. POWER LEVER POSITIONS
NO
RE–RIG HMU AS NECESSARY TO ENSURE QUADRANT BALL DROPS INTO THE DETENT AT IDLE AND MAX. POWER POSITIONS (REF. 71–00–00 CHECK NO. 9)
CHECK ENGINE NOW MAKES TAKE–OFF POWER FOR THE DAY
NO
YES
ADJUST EEC AUTHORITY (N1 DROP) UNTIL TAKE–OFF POWER CAN BE ACHIEVED. (REF. EEC AUTHORITY CHECK) (SEE NOTE 1)
CHECK EEC AUTHORITY (N1 DROP) AND ADJUST AS NECESSARY TO MEET ENGINE MAINTENANCE MANUAL REQUIREMENTS (REF. CHECK NO. 6)
CHECK THAT HMU MEETS REQUIRED MIN. Wf (REF. CHECK NO. 6) (SEE NOTE 2)
YES
NO
CHECK ENGINE NOW MAKES TAKE–OFF POWER FOR THE DAY
YES
NO
SWAP EEC'S BETWEEN LEFT & RIGHT ENGINES (REF. 73–20–03)
CHECK ENGINE NOW MAKES TAKE–OFF POWER FOR THE DAY AND PROBLEM HAS TRANSFERRED TO THE OPPOSITE ENGINE
YES
NO
REPLACE EEC (REF. 73–20–03)
CHECK ENGINE NOW MAKES TAKE–OFF POWER FOR THE DAY AND PROBLEM HAS TRANSFERRED TO THE OPPOSITE ENGINE
SWAP HMU BETWEEN LEFT & RIGHT ENGINES (REF. 73–20–02)
YES
RETURN ENGINE TO SERVICE
REPLACE HMU (REF. 73–20–02)
(SEE NOTE 2 BEFORE PROCEEDING TO HMU REMOVAL)

C92639

Engine Does Not Meet Take-Off Power For The Day
Figure 129 (Sheet 1 of 2)

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

NOTE 1: UNSATISFACTORILY ADJUSTED HMU'S EEC AUTHORITY CAN RESULT IN LACK OF ABILITY TO MAKE TAKE–OFF POWER. THIS SITUATION COULD OCCUR IF THE N1% DROP IS TOO LARGE.

CAUTION:

IN ORDER TO PERFORM A VALID EEC AUTHORITY CHECK THE ENGINE MUST BE AT N1 TAKE–OFF POWER FOR THE DAY IN THE EEC ON MODE. SUCCESSFUL COMPLETION OF INITIAL EEC AUTHORITY CHECK(S) BELOW WILL ALLOW THE PARAMETERS NECESSARY TO PERFORM A VALID EEC AUTHORITY CHECK. IF THE ENGINE CANNOT MAKE TAKE–OFF POWER FOR THE DAY, PERFORM THE FOLLOWING STEPS TO ENSURE A VALID EEC AUTHORITY CHECK:

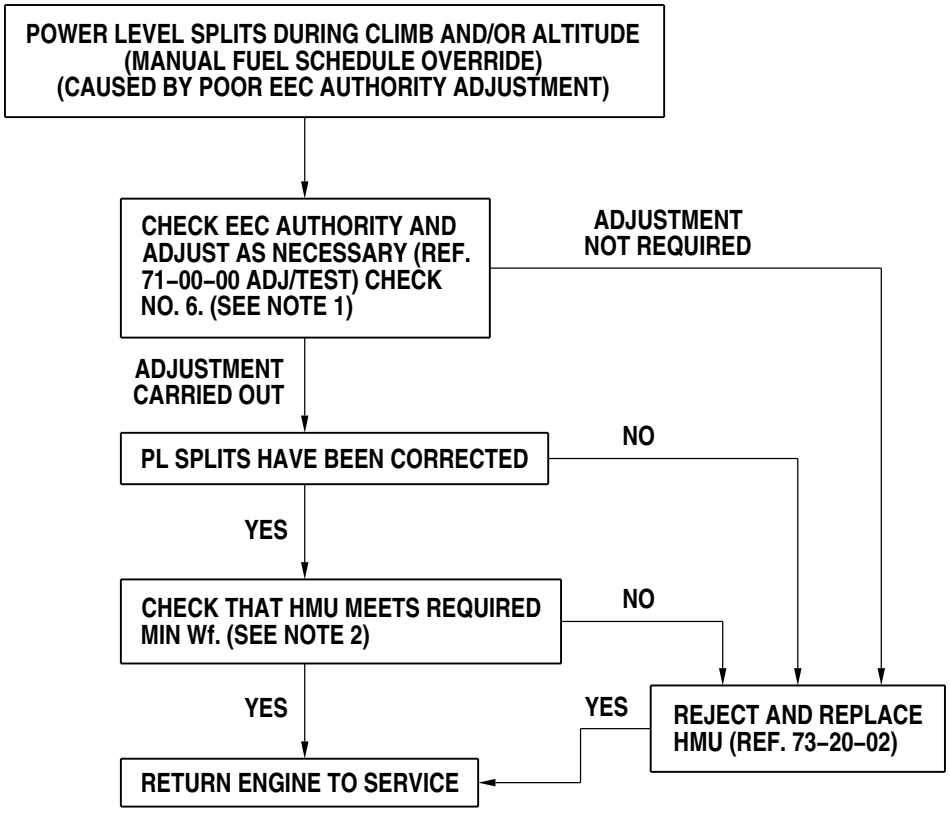
- **PERFORM AN INTERIM ADJUSTMENT OF EEC AUTHORITY VIA THE HMU'S PRESSURE REGULATING VALVE. (THIS ACTION IS PERFORMED TO INITIALLY RECOVER THE ENGINE'S ABILITY TO MAKE TAKE–OFF N1 IN THE EEC ON MODE IN ORDER THAT VALID EEC AUTHORITY CHECKS MAY BE PERFORMED).**
- **IN THESE CASES, ADJUSTMENT TO RECOVER TAKE–OFF N1 POWER SHOULD BE AIMED AT REDUCING THE N1% DROPS IN SMALL AMOUNTS.**
- **RUN ENGINE AND ATTEMPT TO ACHIEVE TAKE–OFF N1 POWER.**
- **REPEAT THE ABOVE STEPS, AS NECESSARY UNTIL TAKE–OFF POWER FOR THE DAY IS ACHIEVED (ONLY THEN CAN A VALID EEC AUTHORITY CHECK IS PERFORMED).**
- **WHEN THE ENGINE'S ABILITY TO ACHIEVE TAKE–OFF N1 POWER HAS BEEN RESTORED, PERFORM A VALID EEC AUTHORITY CHECK AND ADJUST AS NECESSARY TO MEET MAINTENANCE MANUAL REQUIREMENTS (REF. 71–00–00, ADJUSTMENT / TEST).**

NOTE 2: MINIMUM Wf WILL NOT AFFECT THE ENGINE'S ABILITY TO MAKE TAKE–OFF POWER, BUT MINIMUM Wf WILL BE ALTERED BY EEC AUTHORITY ADJUSTMENT. IF THE MINIMUM Wf IS FOUND TO BE OUT OF LIMITS THEN THE HMU HAS TO BE REPLACED.
PRIOR TO REMOVING THE HMU, IF THE MINIMUM Wf IS FOUND TO BE SLIGHTLY OUT OF LIMITS, THEN A SMALL ADJUSTMENT OF THE EEC AUTHORITY WITHIN THE ADJUSTMENT TOLERANCE BAND IS RECOMMENDED.
IT MAY BE POSSIBLE TO BRING MINIMUM Wf INTO LIMITS WHILE STILL ALLOWING SUFFICIENT EEC AUTHORITY MARGIN TO MAKE TAKE–OFF POWER.

C92793

Engine Does Not Meet Take-Off Power For The Day
Figure 129 (Sheet 2)

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.


POWER LEVEL SPLITS DURING CLIMB AND/OR ALTITUDE
(MANUAL FUEL SCHEDULE OVERRIDE)
(CAUSED BY POOR EEC AUTHORITY ADJUSTMENT)
CHECK EEC AUTHORITY AND ADJUST AS NECESSARY (REF. 71–00–00 ADJ/TEST) CHECK NO. 6. (SEE NOTE 1)
ADJUSTMENT NOT REQUIRED
ADJUSTMENT CARRIED OUT
PL SPLITS HAVE BEEN CORRECTED
NO
YES
CHECK THAT HMU MEETS REQUIRED MIN Wf. (SEE NOTE 2)
NO
YES
YES
REJECT AND REPLACE HMU (REF. 73–20–02)
RETURN ENGINE TO SERVICE

C92640

Power Lever Splits During Climb And/Or at Altitude
Figure 130 (Sheet 1 of 2)

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

NOTE 1: UNSATISFACTORILY ADJUSTED HMU'S EEC AUTHORITY OFTEN CAUSES POWER LEVER (PL) SPLITS DURING CLIMB AND/OR AT ALTITUDE. THESE SPLITS CAN OCCUR WHEN THE HMU'S EEC AUTHORITY N1% DROP IS SET TOO SMALL (REF. 71–00–00 ADJUSTMENT / TEST, EEC AUTHORITY CHECKS).

CAUTION:

TO PERFORM A VALID EEC AUTHORITY CHECK, THE ENGINE MUST BE AT TAKE–OFF N1 POWER FOR THE DAY IN THE EEC ON MODE. TO CHECK FOR EEC AUTHORITY AS THE CAUSE OF PL SPLITS DURING CLIMB OR ALTITUDE, PERFORM THE FOLLOWING:

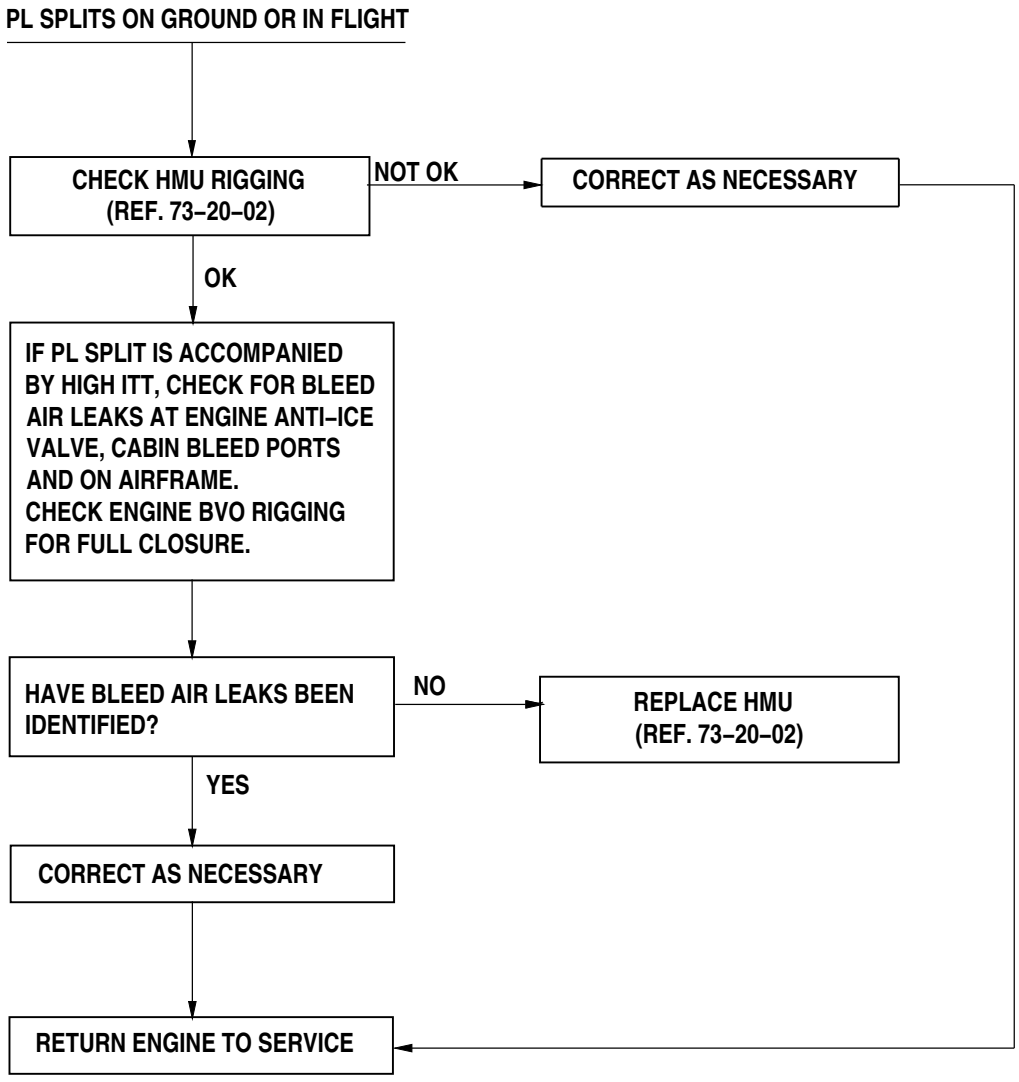
- **PERFORM AN INITIAL EEC AUTHORITY CHECK (REF. 71–00–00 ADJUSTMENT / TEST). IF THERE IS NO VISIBLE N1 DROP WHEN THE EEC IS SELECTED OFF AT TAKE–OFF POWER THEN MAKE A SMALL ADJUSTMENT TO THE EEC AUTHORITY VIA THE HMU'S PRESSURE REGULATING VALVE. THIS SMALL ADJUSTMENT SHOULD BE AIMED AT INCREASING THE N1% DROP.**
- **FOLLOWING THE ADJUSTMENT, PERFORM THE EEC AUTHORITY CHECK AGAIN.**
- **REPEAT THE ABOVE STEPS UNTIL AN N1 DROP VALUE IS OBSERVED. AN OBSERVED N1 DROP INDICATES THERE IS SUFFICIENT EEC AUTHORITY TO PERFORM A VALID EEC AUTHORITY CHECK.**
- **PERFORM AN EEC AUTHORITY CHECK AND ADJUST AS NECESSARY TO MEET MAINTENANCE MANUAL REQUIREMENTS (REF. 71–00–00, ADJUSTMENTS / TEST).**

NOTE 2: MINIMUM Wf WILL NOT AFFECT PL SPLITS BUT MINIMUM Wf WILL BE ALTERED BY EEC AUTHORITY ADJUSTMENT. IF THE MINIMUM Wf IS FOUND TO BE OUT OF LIMITS, THEN THE HMU HAS TO BE REJECTED AND REPLACED. PRIOR TO REMOVING THE HMU, IF THE MINIMUM Wf IS FOUND TO BE SLIGHTLY OUT OF LIMITS, THEN A SMALL ADJUSTMENT OF THE EEC AUTHORITY WITHIN THE ADJUSTMENT TOLERANCE BAND IS RECOMMENDED. IT MAY BE POSSIBLE TO BRING MINIMUM Wf INTO LIMITS WHILE STILL ALLOWING SUFFICIENT EEC AUTHORITY MARGIN TO ELIMINATE PL SPLITS.

C92792A

Power Lever Splits During Climb And/Or at Altitude
Figure 130 (Sheet 2)

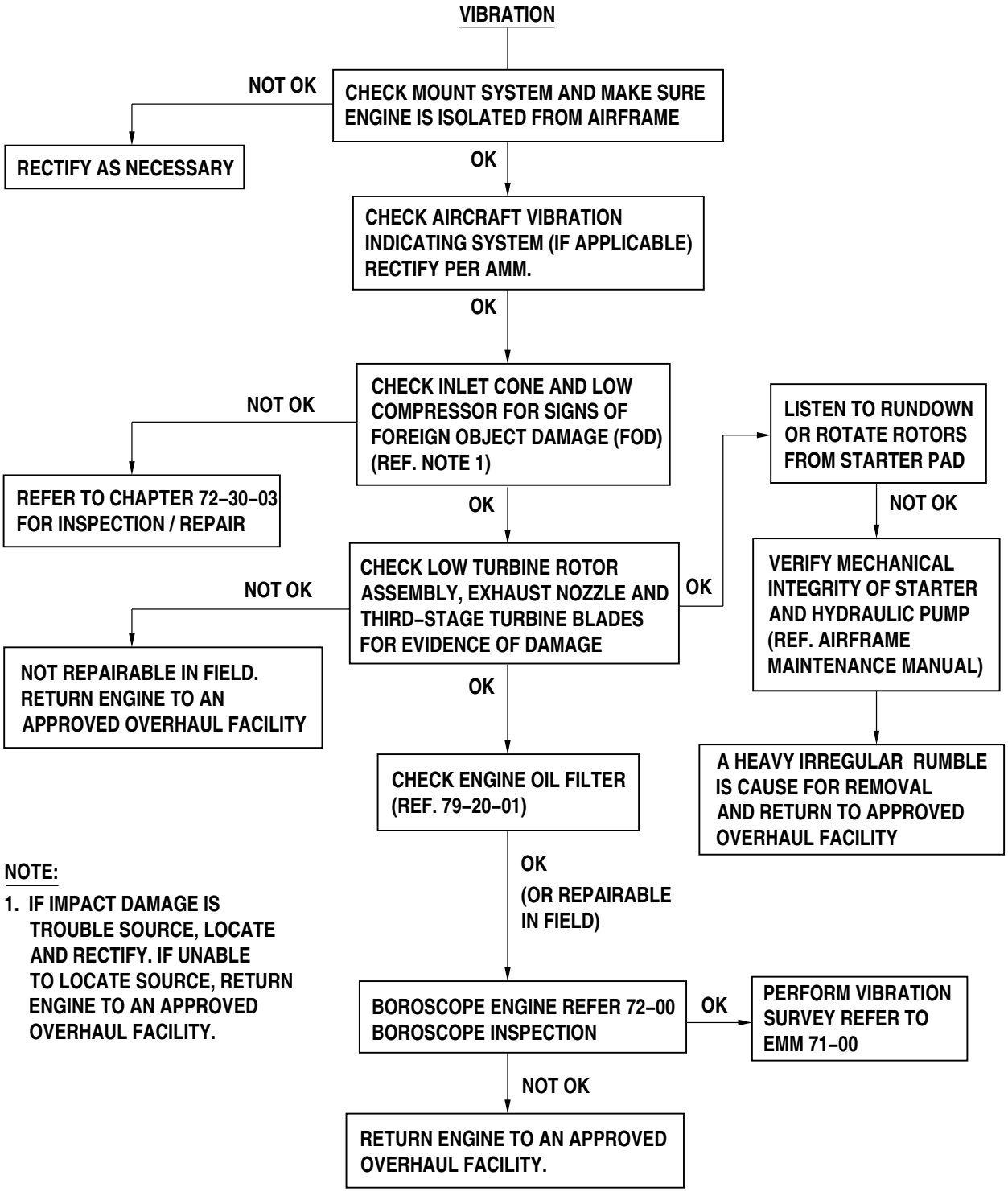
P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.


PL SPLITS ON GROUND OR IN FLIGHT
CHECK HMU RIGGING (REF. 73–20–02)
NOT OK
CORRECT AS NECESSARY
OK
IF PL SPLIT IS ACCOMPANIED BY HIGH ITT, CHECK FOR BLEED AIR LEAKS AT ENGINE ANTI–ICE VALVE, CABIN BLEED PORTS AND ON AIRFRAME.
CHECK ENGINE BVO RIGGING FOR FULL CLOSURE.
HAVE BLEED AIR LEAKS BEEN IDENTIFIED?
NO
REPLACE HMU (REF. 73–20–02)
YES
CORRECT AS NECESSARY
RETURN ENGINE TO SERVICE

C93191

Power Lever Splits During Ground Operation or In Flight
Figure 131

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

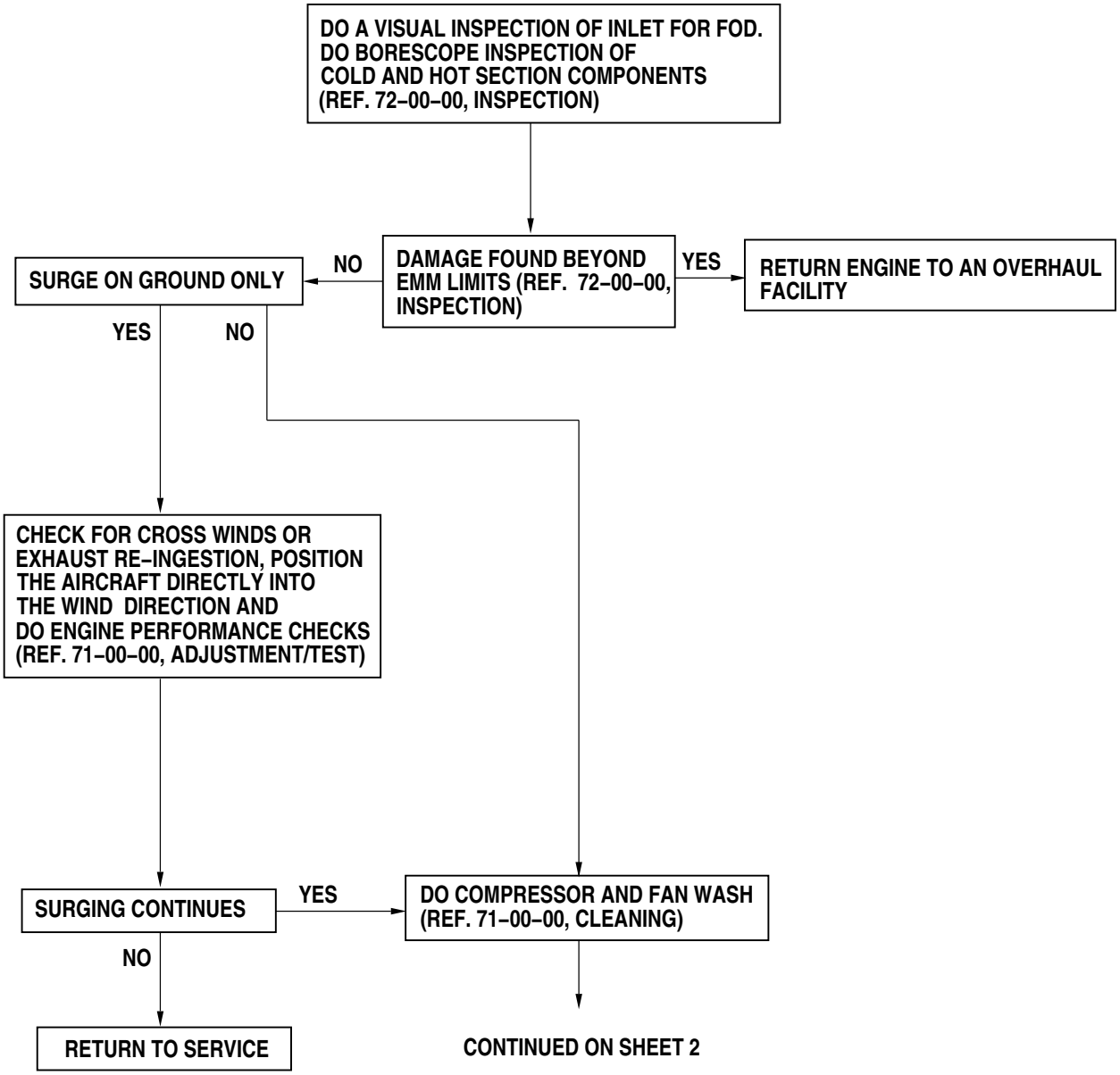

VIBRATION
CHECK MOUNT SYSTEM AND MAKE SURE ENGINE IS ISOLATED FROM AIRFRAME
NOT OK
RECTIFY AS NECESSARY
OK
CHECK AIRCRAFT VIBRATION INDICATING SYSTEM (IF APPLICABLE) RECTIFY PER AMM.
OK
CHECK INLET CONE AND LOW COMPRESSOR FOR SIGNS OF FOREIGN OBJECT DAMAGE (FOD) (REF. NOTE 1)
NOT OK
REFER TO CHAPTER 72–30–03 FOR INSPECTION / REPAIR
OK
CHECK LOW TURBINE ROTOR ASSEMBLY, EXHAUST NOZZLE AND THIRD–STAGE TURBINE BLADES FOR EVIDENCE OF DAMAGE
NOT OK
NOT REPAIRABLE IN FIELD. RETURN ENGINE TO AN APPROVED OVERHAUL FACILITY
OK
LISTEN TO RUNDOWN OR ROTATE ROTORS FROM STARTER PAD
NOT OK
VERIFY MECHANICAL INTEGRITY OF STARTER AND HYDRAULIC PUMP (REF. AIRFRAME MAINTENANCE MANUAL)
A HEAVY IRREGULAR RUMBLE IS CAUSE FOR REMOVAL AND RETURN TO APPROVED OVERHAUL FACILITY
CHECK ENGINE OIL FILTER (REF. 79–20–01)
OK
(OR REPAIRABLE IN FIELD)
BOROSCOPE ENGINE REFER 72–00 BOROSCOPE INSPECTION
OK
PERFORM VIBRATION SURVEY REFER TO EMM 71–00
NOT OK
RETURN ENGINE TO AN APPROVED OVERHAUL FACILITY.
NOTE:
1. IF IMPACT DAMAGE IS TROUBLE SOURCE, LOCATE AND RECTIFY. IF UNABLE TO LOCATE SOURCE, RETURN ENGINE TO AN APPROVED OVERHAUL FACILITY.

C197252

Vibration
Figure 132

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

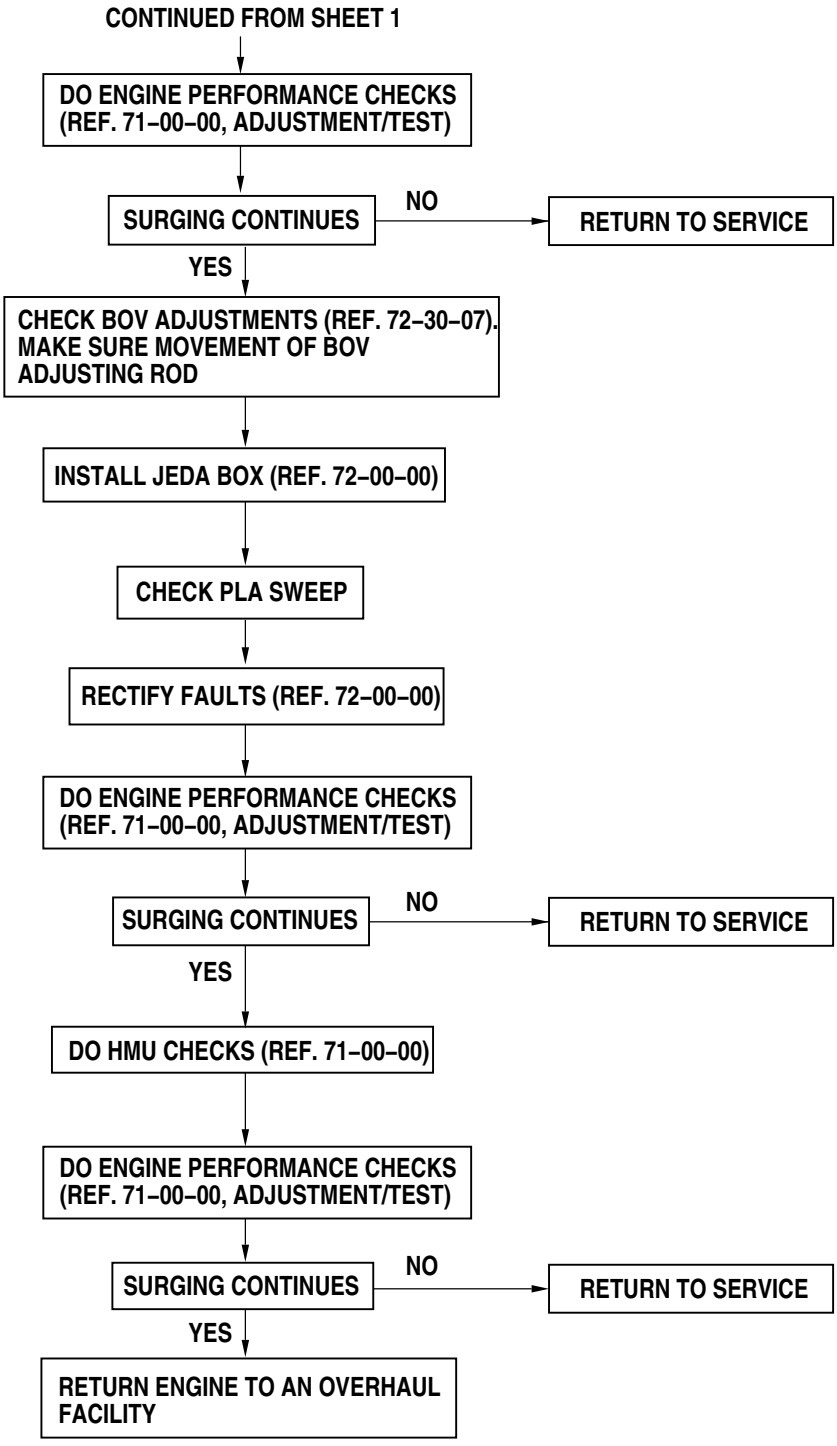
ENGINE SURGE


DO A VISUAL INSPECTION OF INLET FOR FOD.
DO BORESCOPE INSPECTION OF
COLD AND HOT SECTION COMPONENTS
(REF. 72–00–00, INSPECTION)
DAMAGE FOUND BEYOND EMM LIMITS (REF. 72–00–00, INSPECTION)
NO
YES
RETURN ENGINE TO AN OVERHAUL FACILITY
SURGE ON GROUND ONLY
YES
NO
CHECK FOR CROSS WINDS OR EXHAUST RE–INGESTION, POSITION THE AIRCRAFT DIRECTLY INTO THE WIND DIRECTION AND
DO ENGINE PERFORMANCE CHECKS
(REF. 71–00–00, ADJUSTMENT/TEST)
SURGING CONTINUES
YES
DO COMPRESSOR AND FAN WASH
(REF. 71–00–00, CLEANING)
NO
RETURN TO SERVICE
CONTINUED ON SHEET 2

C196146

Engine Surge
Figure 133 (Sheet 1 of 2)

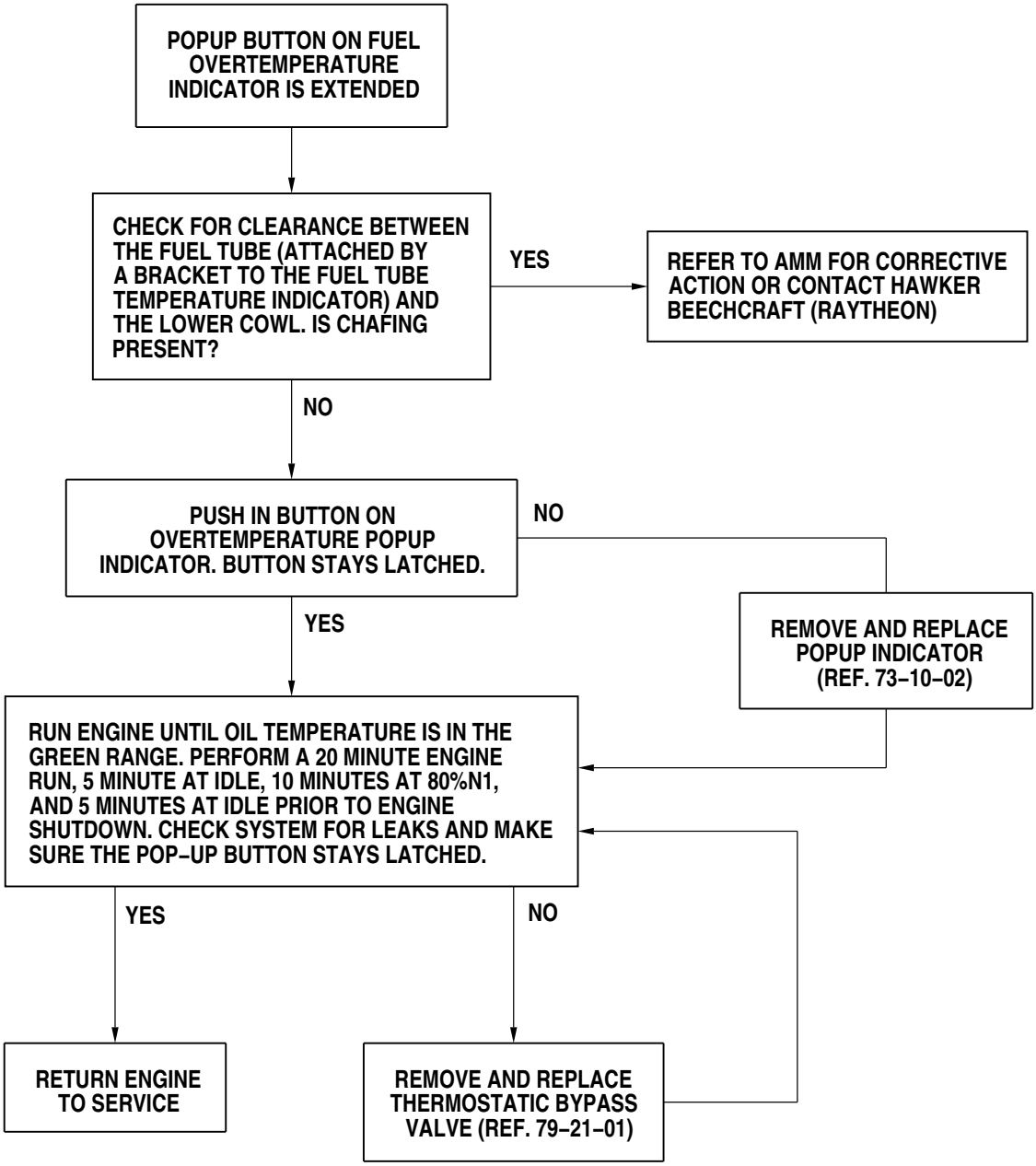
P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.



C196207

Engine Surge
Figure 133 (Sheet 2)

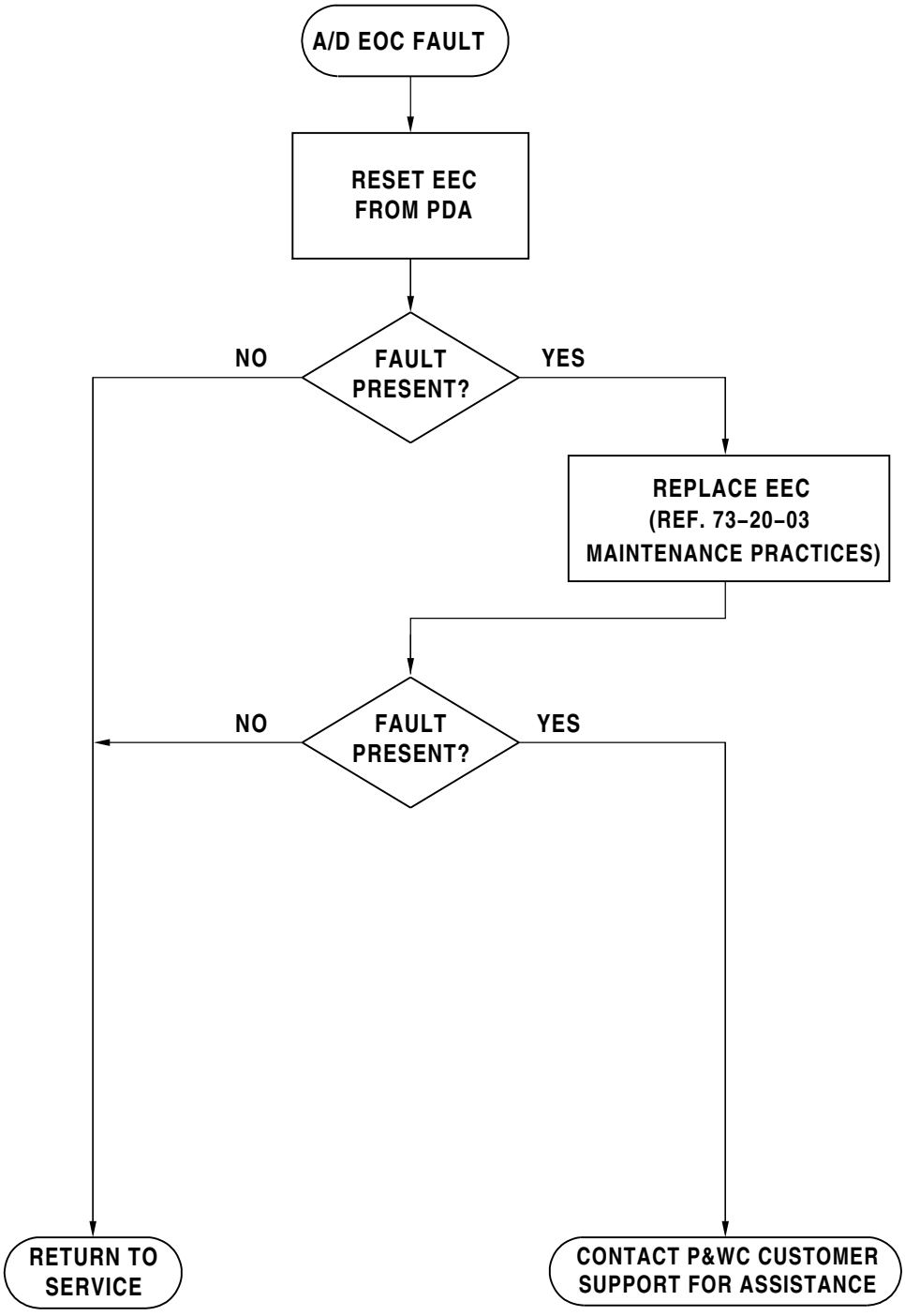
P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.


POPUP BUTTON ON FUEL OVERTEMPERATURE INDICATOR IS EXTENDED
CHECK FOR CLEARANCE BETWEEN THE FUEL TUBE (ATTACHED BY A BRACKET TO THE FUEL TUBE TEMPERATURE INDICATOR) AND THE LOWER COWL. IS CHAFING PRESENT?
YES
REFER TO AMM FOR CORRECTIVE ACTION OR CONTACT HAWKER BEECHCRAFT (RAYTHEON)
NO
PUSH IN BUTTON ON OVERTEMPERATURE POPUP INDICATOR. BUTTON STAYS LATCHED.
NO
REMOVE AND REPLACE POPUP INDICATOR (REF. 73–10–02)
YES
RUN ENGINE UNTIL OIL TEMPERATURE IS IN THE GREEN RANGE. PERFORM A 20 MINUTE ENGINE RUN, 5 MINUTE AT IDLE, 10 MINUTES AT 80%N1, AND 5 MINUTES AT IDLE PRIOR TO ENGINE SHUTDOWN. CHECK SYSTEM FOR LEAKS AND MAKE SURE THE POP–UP BUTTON STAYS LATCHED.
YES
NO
RETURN ENGINE TO SERVICE
REMOVE AND REPLACE THERMOSTATIC BYPASS VALVE (REF. 79–21–01)

C170530

Overtemperature Popup Indicator Activation - JT15D-5R Engines
Figure 134

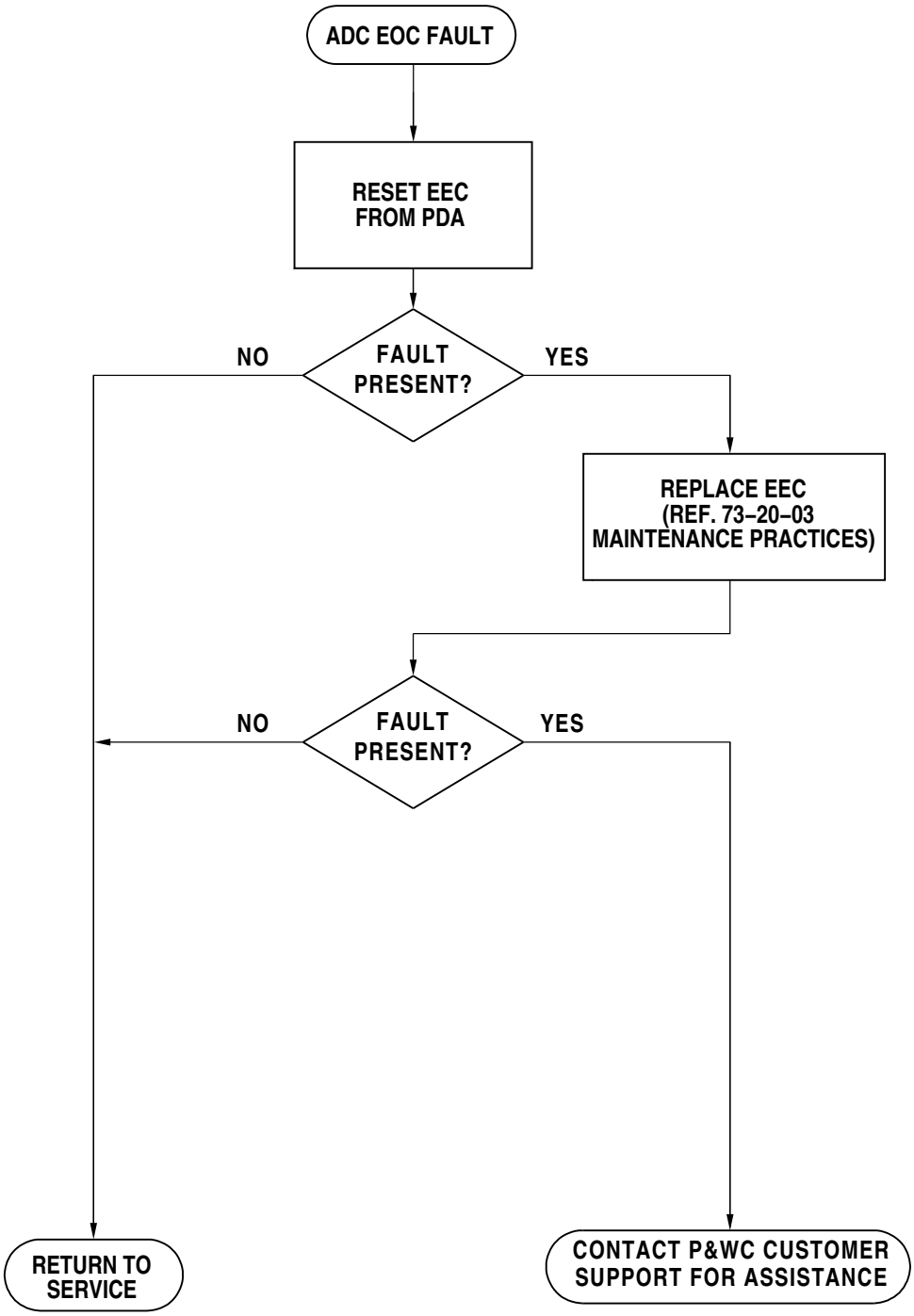
P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.



C149103

Analog/Digital End Of Conversion Fault
Figure 135

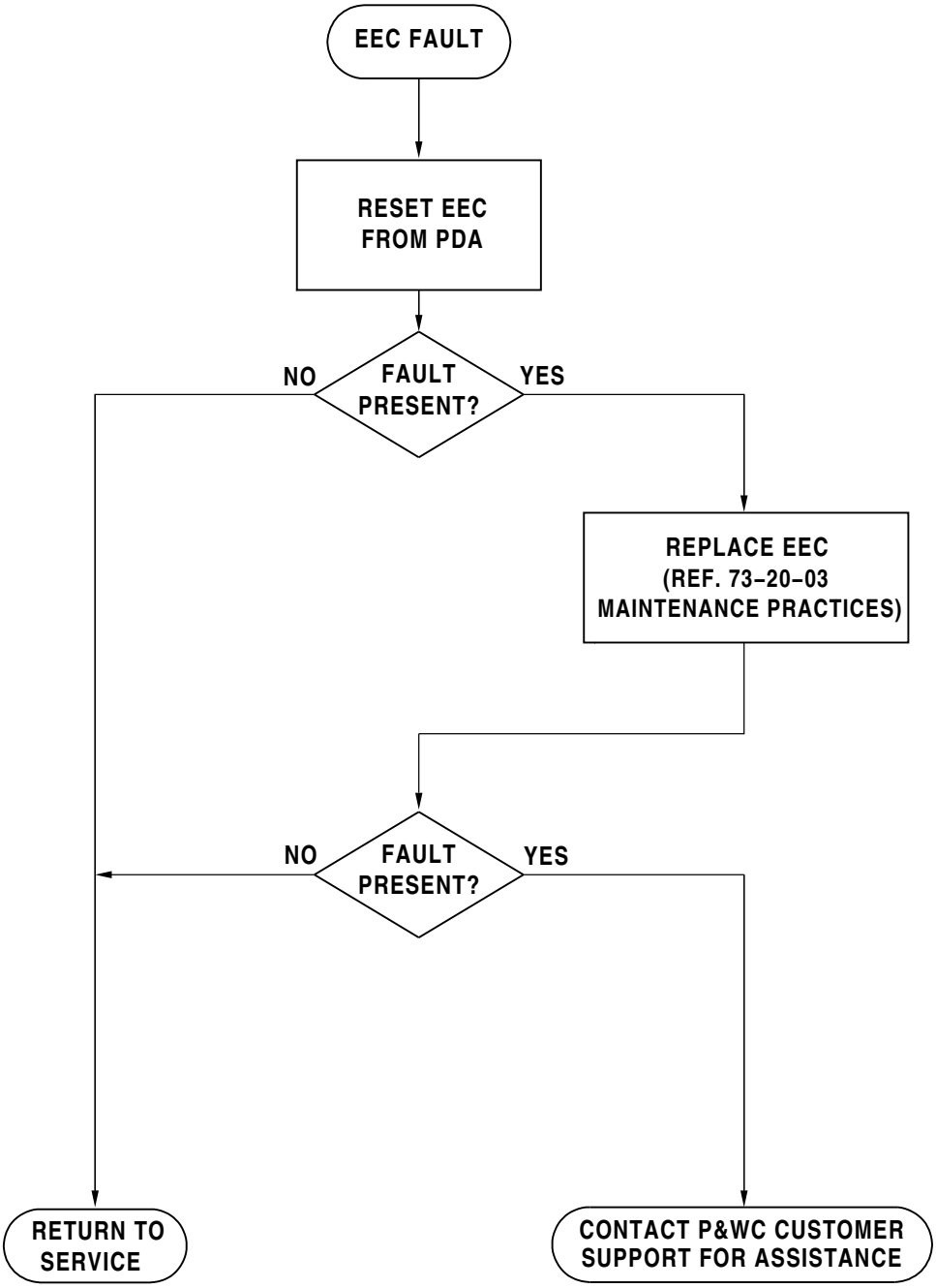
P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.



C149104

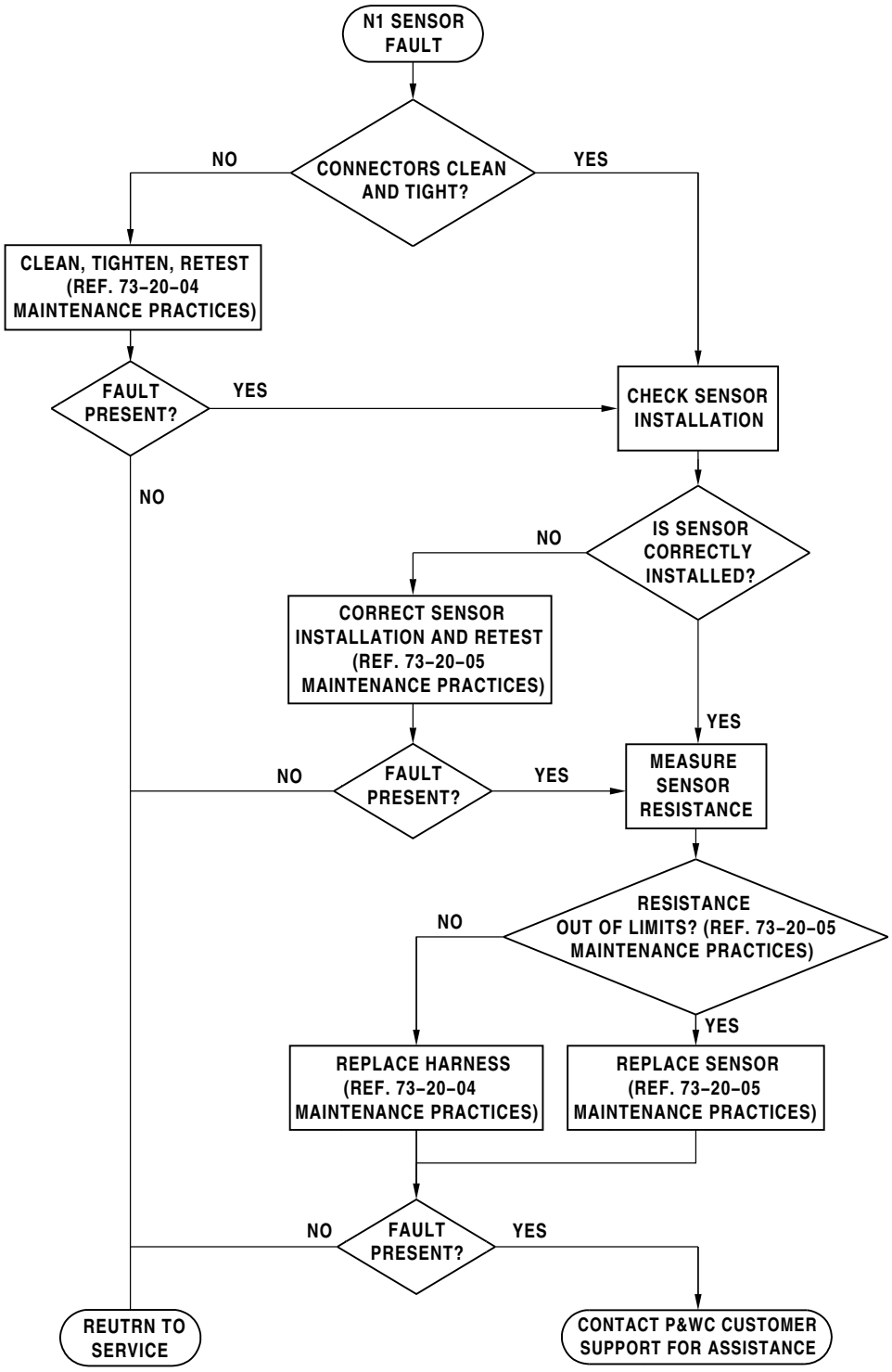
Analog/Digital Conversion End Of Conversion Fault
Figure 136

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.



C149105

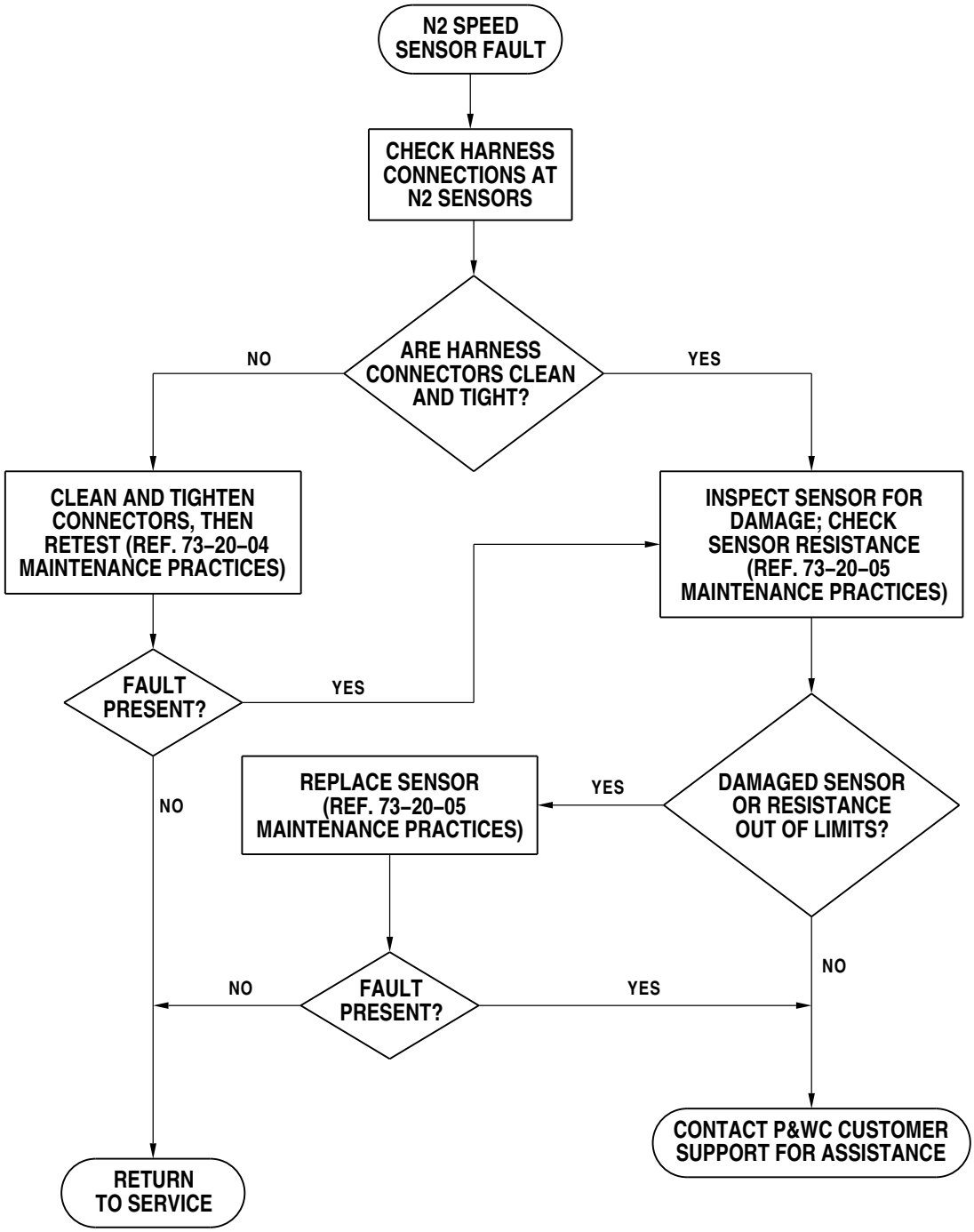
Engine EEC Fault
Figure 137



C149106

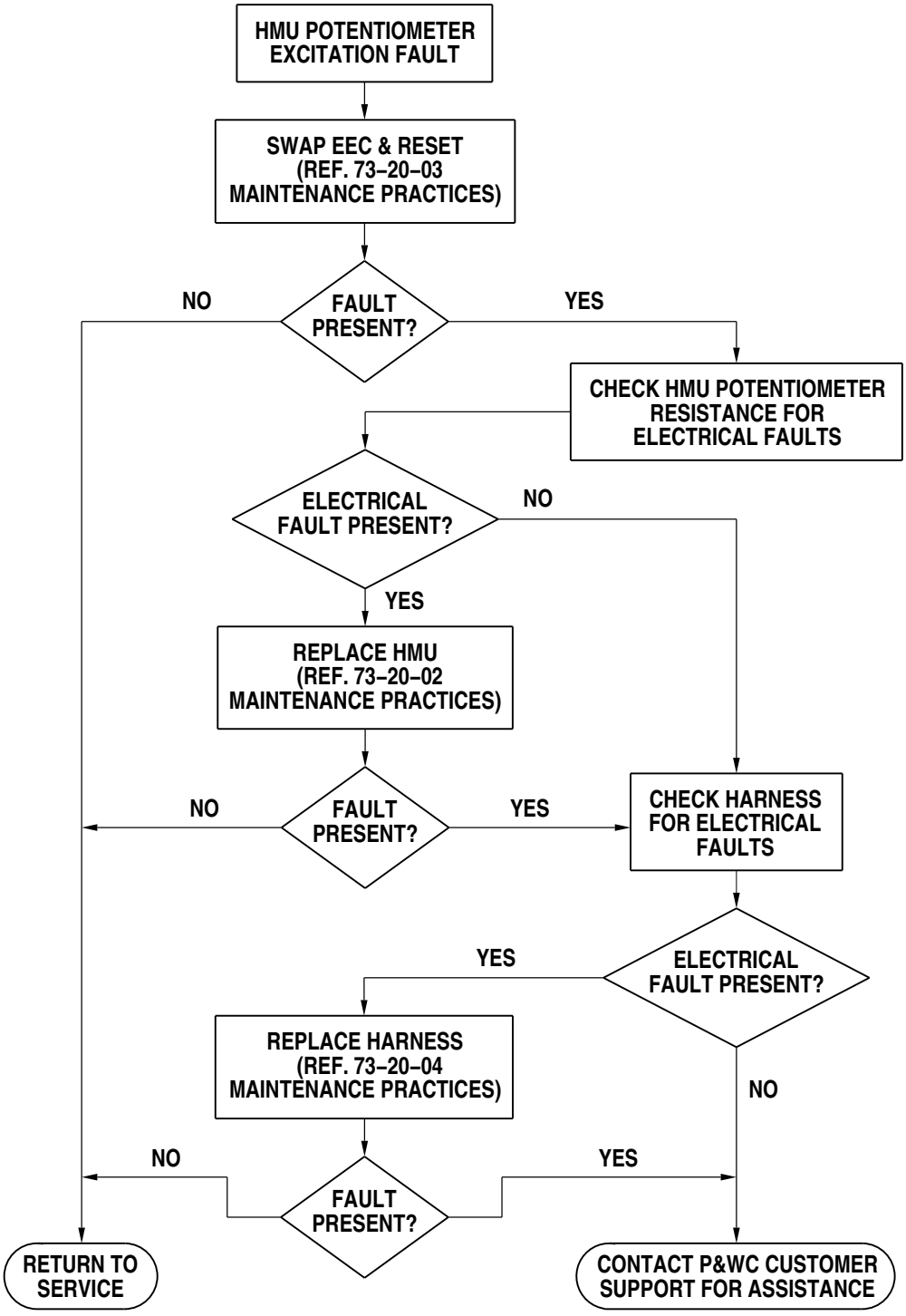
N1 Speed Sensor Fault
Figure 138

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.



C149107

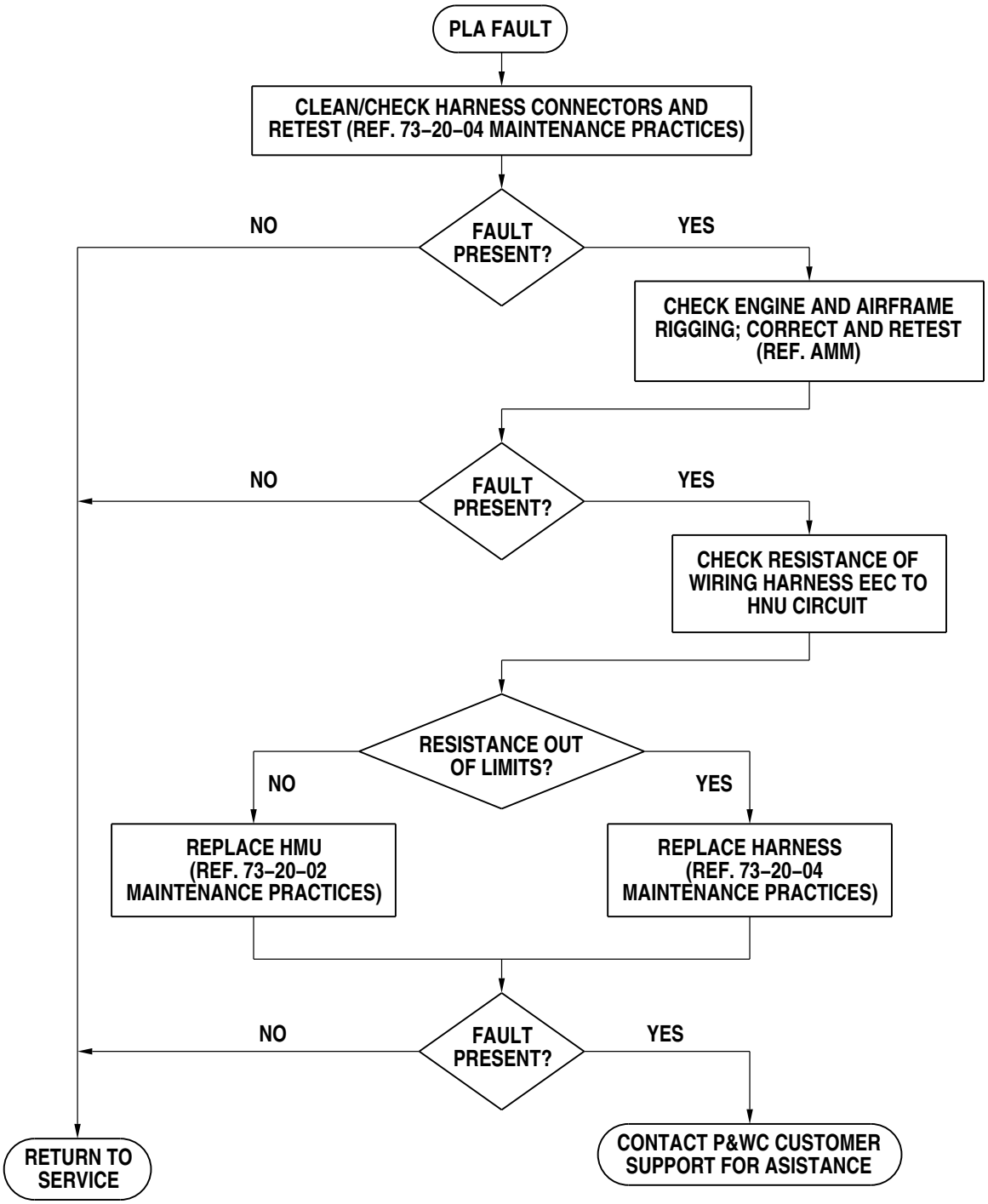
N2 Speed Sensor Fault
Figure 139



C149108

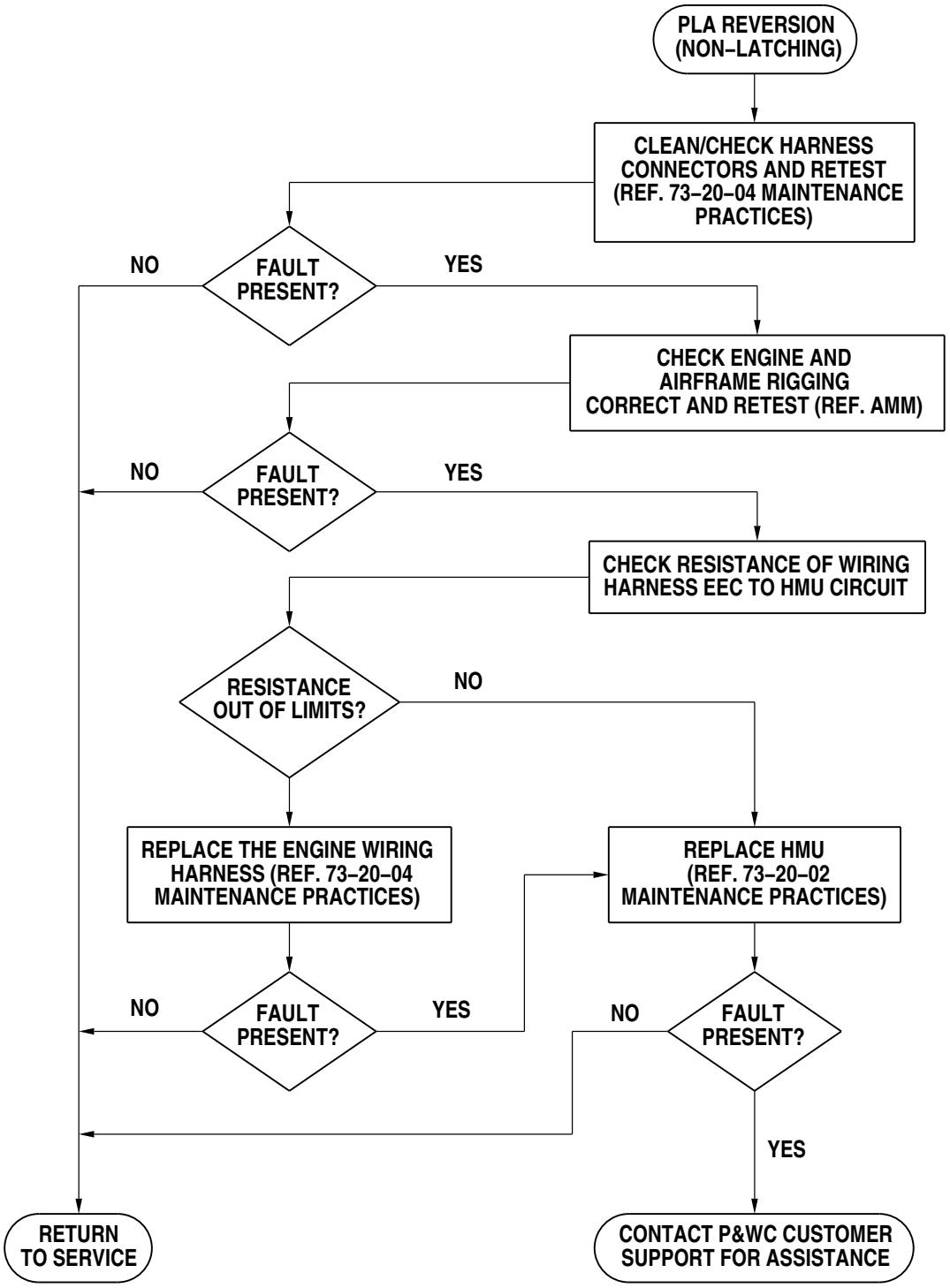
HMU Potentiometer Excitation Fault
Figure 140

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.



C149109

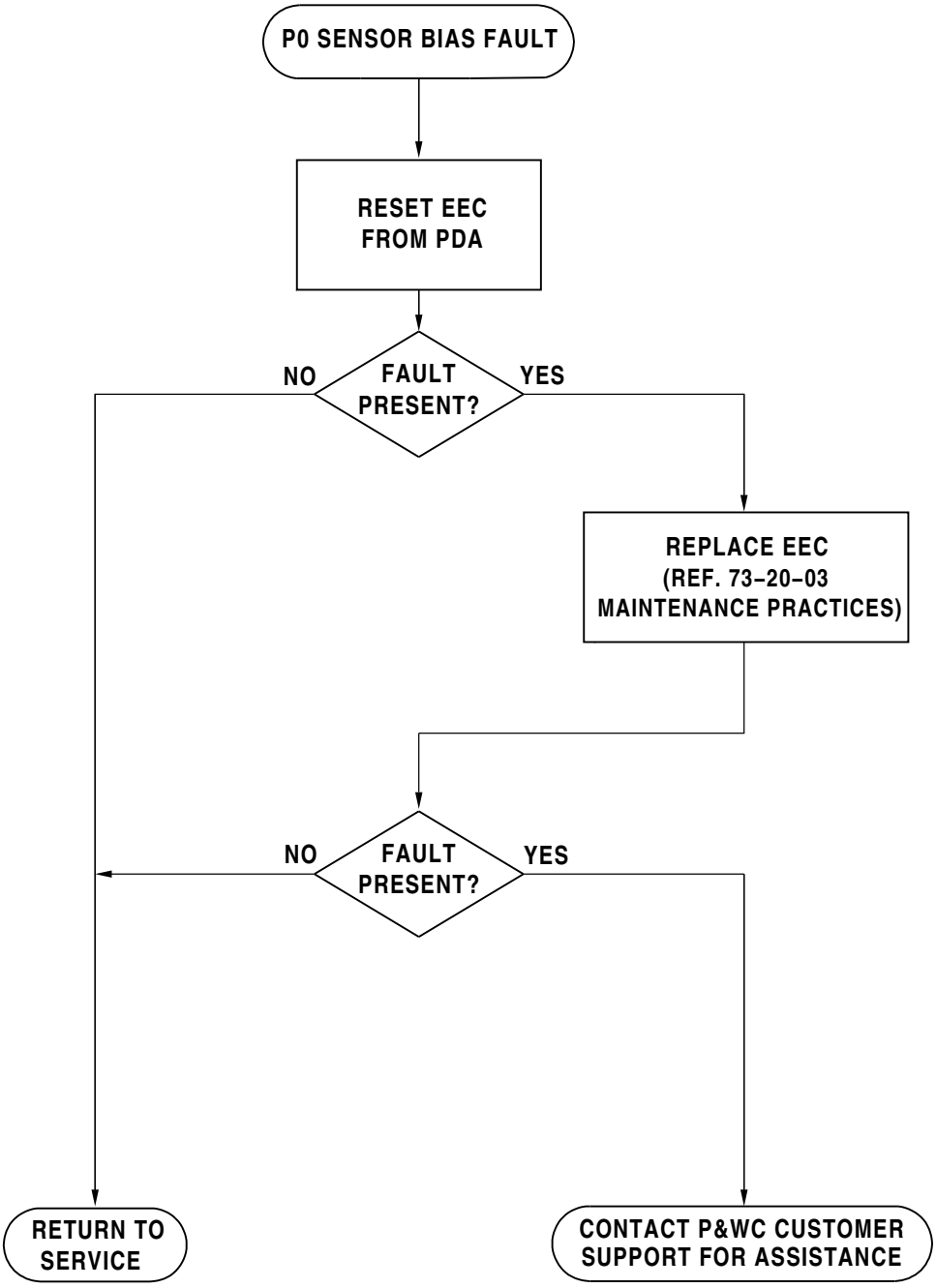
Power Lever Angle (PLA) Fault
Figure 141



C149110

Power Lever Angle Reversion Non-Latching Fault
Figure 142

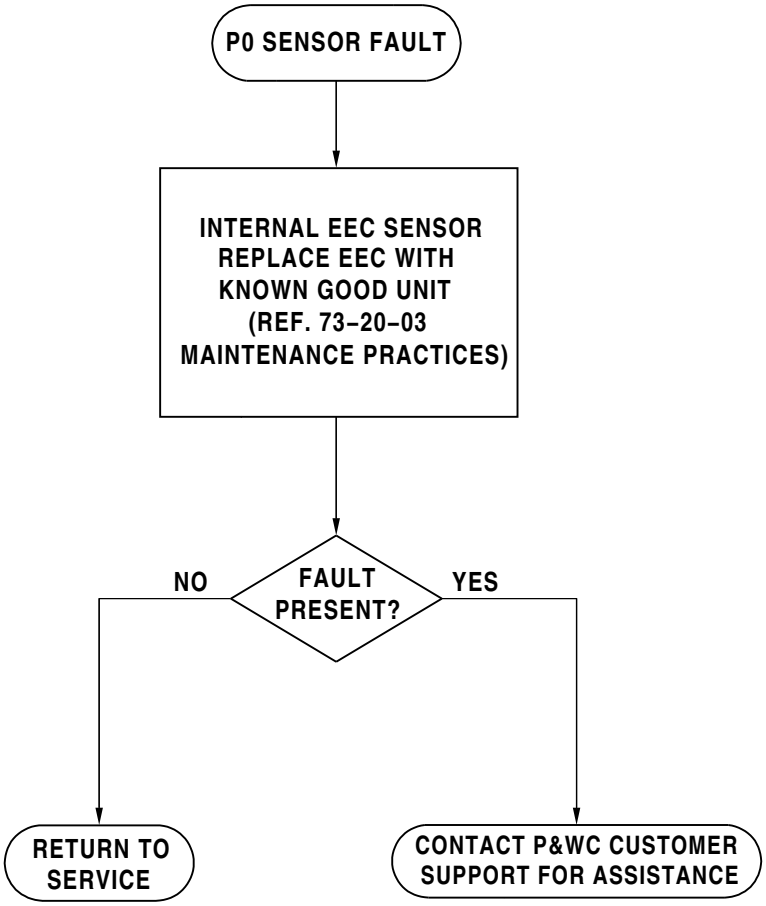
P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.



C149111

P0 Sensor Bias Fault
Figure 143

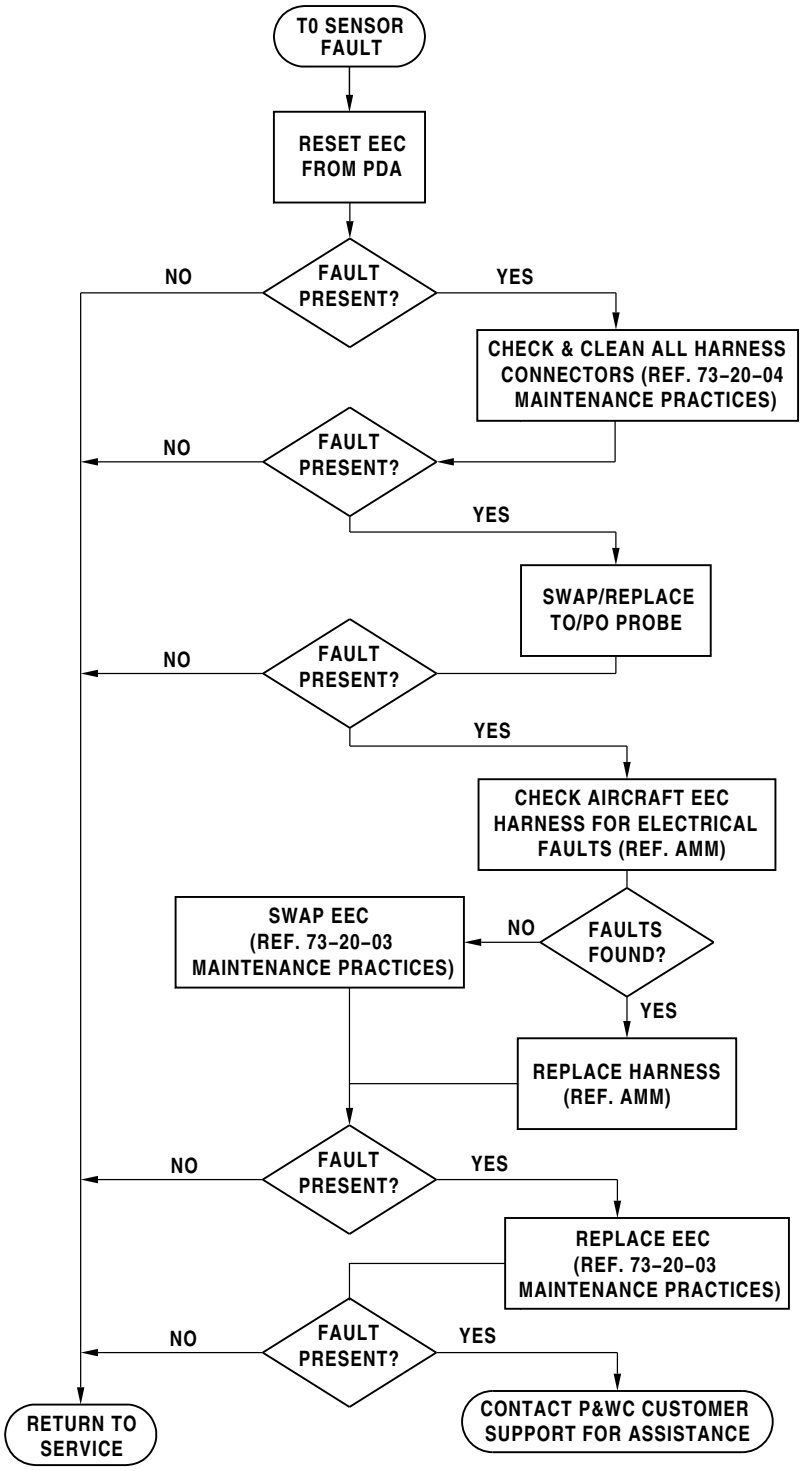
P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.



C149112

P0 Sensor Fault
Figure 144

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.



C149113

T0 Sensor Fault
Figure 145

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

ENGINE: TURBINE - SERVICING

1. General

A. This section provides information and procedures necessary for storage, preservation and depreservation of an engine, and includes instructions for removal and installation of an engine from or into its fiberboard container or engine stand.

NOTE: To install engine in airframe, refer to ENGINE:TURBINE - REMOVAL/ INSTALLATION.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Engine Lubricating Oil
PWC05-063	Strapping Steel
PWC05-070	Pressure Sensitive Tape
PWC05-077	Preservative Oil
PWC05-372	Dye, Liquid, (Blue)
PWC15-001	Silica Gel Desiccant
PWC15-002	Humidity Indicator
PWC15-011	Inhibitor, Engine Rust (External Engine Cold Section)
PWC15-015	Compound, Corrosion Preventative (Water Displacing)

3. Special Tools

The special tools listed below are used in the following procedures.

Tool No.	Name
PWC31000	Maintenance Stand
PWC31503	Engine Lifting Sling
PWC31540	HP Compressor Rotating Wrench

4. Fixtures, Equipment and Supplier Tools

The fixtures, equipment and supplier tools listed below are used in the following procedures.

Name	Remarks
Engine Hoist	Minimum 1025 lb. (466 kg) capacity

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5. Servicing the Engine Oil System

CAUTION: DURING ALL OIL SYSTEM SERVICING, ENSURE EQUIPMENT AND CONTAINERS USED ARE ABSOLUTELY CLEAN. TAKE CARE TO PREVENT INGRESS OF ANY MATTER WHICH COULD CAUSE CONTAMINATION.

A. Engine Oil Filter Element

(1) For JT15D-5 engines: refer to 79-20-01, MAINTENANCE PRACTICES for procedures to remove, install, clean (if applicable) and inspect the engine oil filter element.

(2) For JT15D-5R engines: refer to 79-21-01, MAINTENANCE PRACTICES for procedures to remove, install, clean (if applicable) and inspect the engine oil filter element.

B. Engine Lubricating Oil

(1) The lubrication system oils specified for use in JT15D-5 and JT15D-5R engines are detailed in Pratt & Whitney Canada (P&WC) Service Bulletin SB7001 (latest revision). All oils listed in the bulletin are for use in commercially operated JT15D Series engines and are approved for flight operations.

C. Substitution of Engine Lubricating Oil

CAUTION: WHEN CHANGING FROM AN EXISTING LUBRICANT FORMULATION TO A "THIRD GENERATION" LUBRICANT FORMULATION (AEROSHELL/ROYCO TURBINE OIL 560, EXXON ETO OR MOBIL JET 254), P&WC STRONGLY RECOMMENDS THAT SUCH A CHANGE SHOULD ONLY BE MADE WHEN AN ENGINE IS NEW OR HAS BEEN RECENTLY OVERHAULED.

(1) In cases where oils approved by P&WC are not available and other oils have to be substituted, an operator must obtain prior approval or recommendations for use of such oil from:

Pratt & Whitney Canada Inc.
1000 Marie-Victorin Blvd.
Longueuil, Quebec
Canada J4G 1A1

Attention: Manager - JT15D Customer Support

D. Blue Oil Dye

(1) Blue oil dye (PWC05-372) can be added to any P&WC approved lubricating oil on a one-time basis when you fill the system. The dye improves the sight glass visibility and helps in the detection of oil leaks.

(2) Use 0.122 - 0.171 milliliters per liter, or 0.462 - 0.647 milliliters per U.S. gallon of oil. The maximum concentration must not be more than 0.171 milliliters per liter, or 0.647 milliliters per U.S. gallon.

(3) The dye is blue in color but when mixed with some oils which are yellow in color, the result can be green colored oil.

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E. Oil Analysis

(1) Engine oil sampling and inspection is recommended if visual inspection shows oil is very dark and/or has an unusual odor, and/or exhibits other abnormal properties.

(2) Turbine oils are hygroscopic, i.e. they can attract water molecules from the environment. Hydrolysis can increase the acidity of the oil, or the Total Acid Number (TAN). The acidity can eventually corrode engine parts.

NOTE: As oil deteriorates, the color becomes black and a strong harsh odor is given off. This is not a reason to change the oil, but the oil should be analyzed.

(3) Prepare to take an engine oil sample as follows:

(a) Obtain the sample within 20-30 minutes of engine shutdown.

(b) If the engine is cold, start the engine and ground run until engine oil temperature is 70 °C (158 °F) minimum before obtaining an oil sample to analyze. Shut the engine down.

(4) Take a sample of engine oil from the oil tank drain port. Drain and discard one cup of oil from the tank before collecting the final sample. Collect one sample of 100-125 ml of engine oil into a clean glass container.

(5) Have the engine oil sample analyzed for Total Acid Number (TAN) and water content by one of the methods following:

(a) Send the sample to an approved laboratory to analyze the engine oil sample for Total Acid Number (TAN) and water content. Refer to 79-20-01 for a list of laboratories.

(b) Use a Titra-Lube TAN Test Kit (P/N TI-TAN) to analyze the oil for TAN. Use a Hydroscout kit to test for water content. These kits can be obtained from the following address or contact a local distributor for availability of the kits.

Dexsil Chemical Corp.
1 Hamden Park Drive
Hamden, CT, 06517
USA.

TEL: 1-800-4-DEXSIL
203-288-3509
203-248-6523

(6) The limits are as follows:

- Total Acid Number (TAN): 2 mgKOH/g maximum.
- Water content: 800 ppm maximum.

(7) If the oil analysis exceeds any of the limits above, proceed as follows:

(a) Drain and discard oil from the oil tank (Ref. Para. G.).

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(b) Refill the oil tank with fresh oil (Ref. Para. H.).

F. Oil Level Check

(1) Check contents of oil tank after engine shutdown as follows:

NOTE: To reduce possibility of overfilling and to ensure accurate readings for oil consumption measurement, it is recommended that the oil level always be checked 10 minutes after engine shutdown.

(a) Unlock and remove filler cap and dipstick assembly from filler neck located forward of front flange on intermediate case.

CAUTION: DO NOT MIX DIFFERENT BRANDS OR TYPES OF OIL SINCE THEIR DIFFERENT CHEMICAL STRUCTURES MAY MAKE THEM INCOMPATIBLE. IF DIFFERENT TYPES OF OIL BECOME MIXED, DRAIN AND FLUSH SYSTEM AND REFILL WITH NEW OIL.

(b) Check oil tank contents against marking on dipstick and service with approved oil to the ‘‘Max Hot’’ level.

NOTE: The dipstick indicates ‘‘Max Hot’’, ‘‘Max Cold’’ levels and one or two other markings corresponding to ‘‘quantity to be added’’ in U.S. quarts. Ensure that correct dipstick is being used (Ref. Illustrated Parts Catalog, P&WC Manual P/N 3032944).

(c) If oil tank contents are below level of dipstick tip, refer to Chapter 72-00-00, FAULT ISOLATION, Engine Lubrication Problems.

1 Check for external leakage and oil filter contamination.

2 For JT15D-5 engines: clean oil filter (Ref. 79-20-01) and service oil tank (Ref. Subpara H.).

3 For JT15D-5R engines: clean the oil filter (Ref. 79-21-01) and service oil tank (Ref. Subpara H.).

4 Record quantity of oil added to system.

5 Carry out 15 minute engine run (Ref. 71-00-00, ADJUSTMENT/TEST).

6 Check oil level and condition of oil filter. If both are satisfactory, no further action is required. If either is unsatisfactory, refer to Chapter 72-00-00, FAULT ISOLATION, Engine Lubrication Problems.

(d) Install filler cap and dipstick assembly in filler tube. Ensure cap is correctly installed and locked securely.

(2) On engines which have remained stationary for 12 hours or more, proceed as follows:

(a) Check oil tank contents (Ref. step F.(1), preceding), but do not service with oil. If oil level is low, proceed with the following steps:

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1 Drain residual oil from accessory gearbox (Ref. Fig. 301) into a clean container then pour the drained oil into the engine oil tank.

2 Measure engine oil level again (Ref. step F.(1), preceding) and replenish as required.

G. Draining Oil System

(1) Recommendations for oil change intervals are based on the performance of specific brands and types of oil, specific engine models and operating criteria. General oil change intervals may be extended periodically and will be reflected by revisions to Service Bulletin SB7001. Permission for extension of oil drain intervals may be granted to operators through monitoring programs conducted by most major oil companies which have been approved by Pratt & Whitney Canada. Service Bulletin SB7001 will be revised periodically to include newly approved oils.

(a) Procedure (Ref. Fig. 301):

1 Place suitable containers or drip pan under engine.

2 Remove oil filler cap.

3 Remove oil drain plugs located on pressure oil pump body, at bottom of accessory gearbox and at bottom of oil filter housing. For JT15D-5 (BS1191 (Post-SB7599)) and JT15D-5R (BS1221) engines, disconnect chip detector harness connector and remove the chip detector from the self-closing valve (Ref. 79-30-05, MAINTENANCE PRACTICES). Insert suitable equipment to hold the self-closing valve open until the AGB is fully drained.

H. Filling Oil System

(1) Fill engine oil system as follows:

CAUTION: DO NOT TIGHTEN DRAIN PLUGS MORE THAN MAXIMUM TORQUE VALUE.

(a) Proceed as follows: Put new preformed packings on each oil drain plug or chip detector and install drain plugs at respective location as follows (Ref. Fig. 301):

1 Oil filter cover drain plug: put new preformed packing on oil drain plug then install and secure drain plug (Ref. 79-20-01/79-21-01 MAINTENANCE PRACTICES).

2 Oil pump drain plug: put new preformed packing on oil drain plug then install and secure (Ref. 72-60-02, MAINTENANCE PRACTICES).

3 AGB drain location:

a JT15D-5 (Raytheon BS713 and BS1191 and Mitsubishi BS657): tighten and torque the accessory gearbox drain plug to 200 to 225 lb.in. and secure with lockwire.

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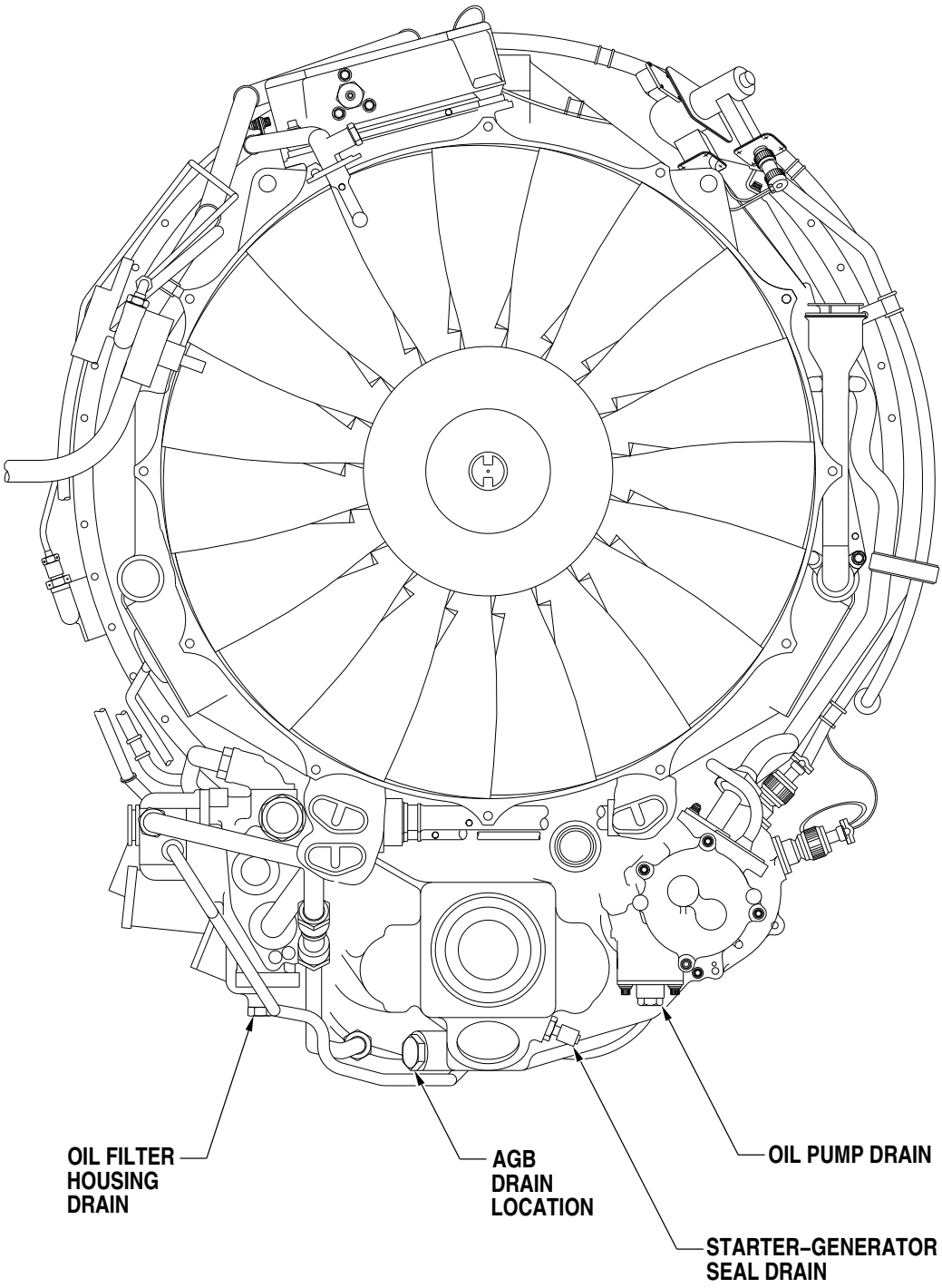

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Location of Oil Drain Plugs (Typical)
Figure 301

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b JT15D-5 (Raytheon BS1191 (Post-SB7599)): install and lock the chip detector in AGB drain bore self-closing valve, then install the chip detector harness connector (Ref. 79-30-05, MAINTENANCE PRACTICES).

c JT15D-5R (Raytheon BS1220): tighten and torque the accessory gearbox drain plug to 200 to 225 lb.in. and secure with lockwire.

d JT15D-5R (Raytheon BS1221): install and lock the chip detector in AGB drain bore self-closing valve, then install the chip detector harness connector (Ref. 79-30-05, MAINTENANCE PRACTICES).

(b) Remove oil filter cover and remove element (Ref. Chapter 79-20-01/79-21-01).

(c) For JT15D-5 engines: clean the oil filter element (Ref. Chapter 79-20-01) and reinstall in the cover.

(d) For JT15D-5R engines: clean the oil filter element and replace if necessary (Ref. Chapter 79-21-01). Reinstall in the cover.

(e) Fill cover with specified oil, install new preformed packings and install the cover on the engine again.

(f) Fill oil tank with approved engine oil (Ref. SB7001) to the ‘‘Max Cold’’ level (Ref. Para. 5.).

(g) Do dry motoring run (Ref. 71-00-00, POWER PLANT - ADJUSTMENT/TEST).

(h) Check oil level and fill oil tank with approved engine oil (Ref. SB7001) to the ‘‘Max Cold’’ level (Ref. Subpara. F.).

I. Flushing Oil System

(1) If an engine is to be operated with an oil brand or type which differs from that on which it previously operated, or if the oil system has been contaminated by other than metallic matter, flush the system as follows:

(a) Place suitable containers or drip pan under engine.

(b) Drain engine oil (Ref. Para. 5.G.).

(c) Fill oil system (Ref. Para. 5.H.).

(d) Start engine (Ref. 71-00-00, ADJUSTMENT/TEST) and run at stabilized IDLE for five minutes.

(e) Shut down engine (Ref. 71-00-00, ADJUSTMENT/TEST) and repeat steps ((b)) and ((d)), preceding.

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6. Storage and Shipping

A. Engine Shipping Container - Description

(1) The fiberboard shipping container comprises a wooden skid base, to which is secured a metal cradle, a fiberboard sleeve forming the sides of the container and a fiberboard cover. The base, cradle and associated hardware are reusable; the fiberboard sleeve and cover are disposable. The container is intended for domestic shipment in a closed conveyance on the North American continent or for overseas shipment by air; it is not intended for shipment by sea.

(2) The container is weather resistant only and should not be exposed to climatic conditions for more than seven days and must not be used for outdoor storage. It also offers protection against corrosion for a period of up to six months, provided that the container is correctly sealed and sheltered indoors in relatively dry area and the color of humidity indicator (PWC15-002)is monitored every 15 days (Ref. Subpara. B., Engine Shipping Container - Humidity Control).

(3) For fiberboard shipping container data refer to Table 301.

B. Engine Shipping Container - Humidity Control

(1) To maintain internal conditions within the protective envelope, at a safe humidity level for storage, twelve bags of desiccant material (PWC15-001)are placed in the protective envelope. Each desiccant bag contains eight units (one unit equals one ounce). A humidity indicator is (PWC15-002) installed within the protective envelope and is visible through a window in the fiberboard casing. The moisture level can thus be checked without disturbing the container or its contents. At a safe humidity level (up to 40 percent relative humidity) the indicator color is blue. As humidity increases the color gradually changes to pink. An all pink color indicates that an unsafe moisture condition has been reached; the desiccant must then be replaced with freshly activated bags (Ref. Para. 6.C., following).

TABLE 301, Fiberboard Shipping Container Data

DESCRIPTION	DATA
Length	74 in. (188 cm)
Width	40 in. (101.6 cm)
Height	47 in. (119.4 cm)
Weight (approx.)	366 lb. (166 kg)

C. Reactivation of Desiccant and Humidity Indicator

(1) Place bags of desiccant (PWC15-001) and humidity indicator (PWC15-002)in a suitable oven controlled at 121°C. The humidity indicator may be removed when an all blue color has been attained. The desiccant bags should remain in the oven for two hours minimum.

(2) Allow oven to cool to room temperature (approximately 72°F) and then remove bags and indicator as applicable.

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(3) Immediately place desiccant bags in airtight polyethylene envelopes. Evacuate all air and heat-seal envelopes.

NOTE: Desiccant bags must be removed from polyethylene bags prior to installation in shipping/storage container.

D. Engine Handling Precautions

(1) When an engine is to be removed from or installed in a fiberboard container, the following precautions must be taken:

(a) Ensure that a hoist of sufficient lifting capacity, plus safety factor, is available to lift loads as follows:

Engine only - 650 lb. (295 Kg) load.
Engine in container - 1025 lb. (466 Kg) load.

(b) Ensure that container or engine is positioned correctly on floor, directly beneath hoist.

(c) Ensure that free overhead space of at least seven feet is available, exclusive of distance from top of container or engine to hook.

E. Removal of Engine from Shipping Container (Ref. Figs. 302 and 303)

CAUTION: IF ENGINE IS DROPPED IN CONTAINER OR OTHERWISE, RETURN ENGINE TO AN APPROVED OVERHAUL FACILITY. INSPECT IN ACCORDANCE WITH OVERHAUL MANUAL INSTRUCTIONS.

(1) Cut and remove strapping (1, Fig. 302) from around fiberboard container. Retain reinforcing corners (2). Remove cover (3) and sleeve (5) from base (6).

(2) Cut protective envelope (7) and expose top of engine.

(3) Remove and discard two bolts (1, Fig. 304) and washers (2) that attach the remote oil indicator panel (3) to right-hand upper mount pad on intermediate case. Install the indicator panel on the engine (Ref. 79-30-02, OIL INDICATOR PANEL-MAINTENANCE PRACTICES).

CAUTION: DO NOT USE ENGINE SLING AND LIFTING BRACKETS TO LIFT AN ENGINE THAT IS STILL ATTACHED TO SKID BASE.

(4) Install sling (PWC31503)(1, Fig. 303):

(a) Secure front wire rope supports to two lifting brackets on rear flange of LP compressor case.

(b) Insert socket-headed capscrew (18) in bracket (17) and install assembly in boss on turbine exhaust duct. Tighten and torque capscrew 150 lb.in. using hexagon head driver (16).

(c) Install dowel pin (23) in bracket (17). Align cable assembly (14) over exhaust duct and secure adapter (24) to bracket (17) using pin (15).

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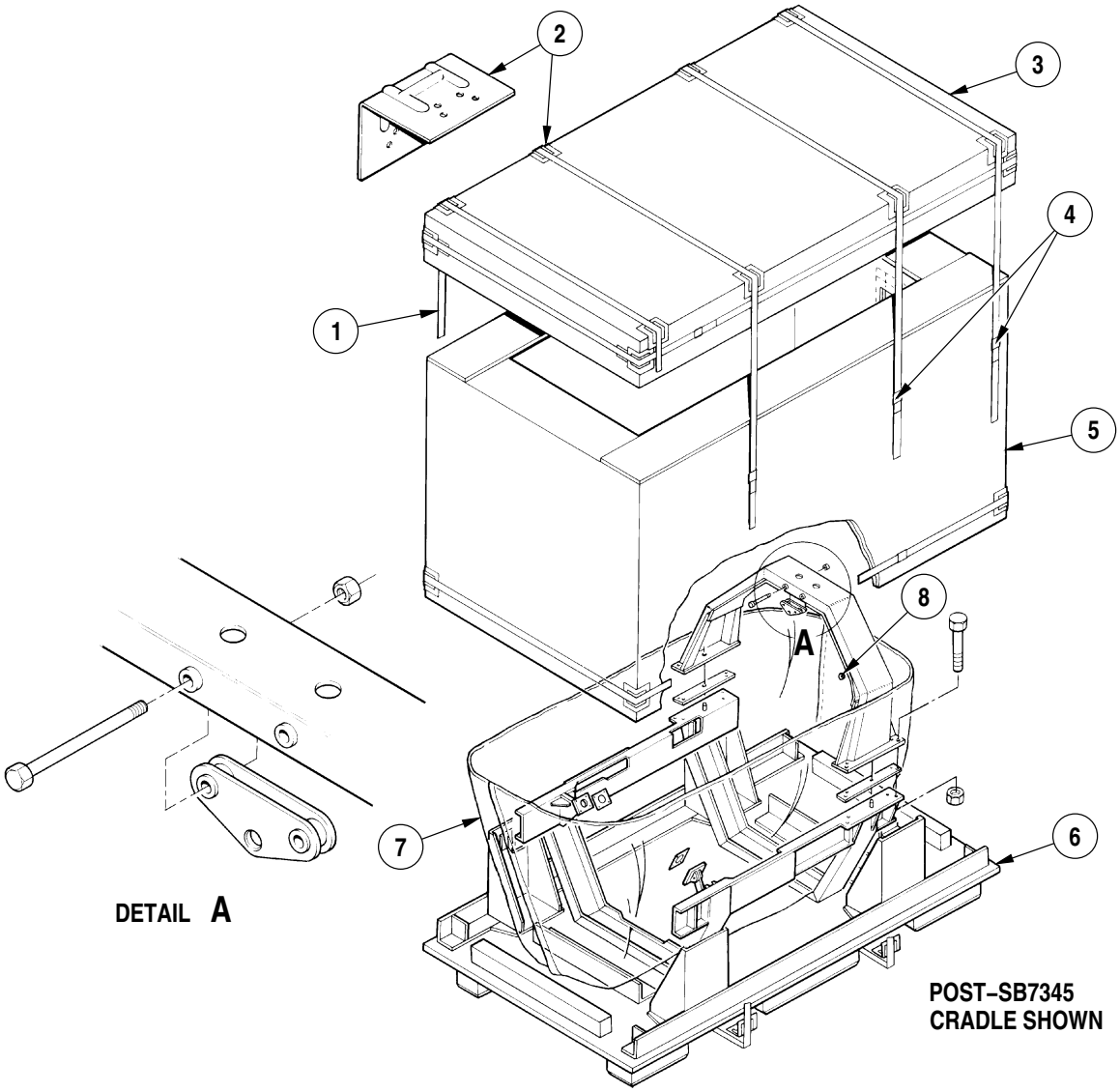

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Fiberboard Shipping Container (Typical)
Figure 302

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Key to Figure 302

1. Strapping
2. Corners
3. Cover
4. Strapping Seal
5. Sleeve
6. Base
7. Envelope
8. Humidity Indicator

(5) Adjust lifting-eye of sling (1) to ensure horizontal lift.

CAUTION: DO NOT USE ENGINE SLING AND LIFTING BRACKETS TO LIFT AN ENGINE THAT IS STILL ATTACHED TO SKID BASE.

(6) Take weight of engine on sling and remove two nuts (6) and bolts (2) securing rear support (3) to rear shipping mount bracket (5).

(7) Remove eight nuts (9) and bolts (8) securing support (3) to cradle (7). Lift rear support clear of engine taking particular care not to strike any part of engine.

(8) Remove two lockpins (12), cotterpins (19), washers (13), and pins (20), at front lower engine mount brackets (11).

CAUTION: DO NOT ALLOW ENGINE TO CONTACT ANY PART OF ENGINE CRADLE DURING REMOVAL.

(9) Raise engine clear of cradle (7) ensuring that engine does not swing.

(10) Remove eight bolts securing front mount brackets (11) to engine mount pads and remove brackets. Install engine in stand (Ref. Subpara. A., following).

(11) Unscrew self-locking nut (21) and bolt (22) from rear shipping mount bracket (5) and remove bracket from rear mount of engine.

(12) Remove desiccant bags (PWC15-001)for reactivation (Ref. Subpara. C., following). Remove and discard protective envelope and consumable items.

(13) Remove envelope containing engine log book and relevant records from folding box on skid base assembly. Store reusable parts of container with associated hardware in a dry area.

(14) For Post-SB7477: Remove the fuel pressure tube support strut (31) for the fuel pressure to cooler tube (39) from fan case before installing engine in airframe as follows:

(a) Remove nut (34), bolt (32) and washer (33) from attached engine shipping nose cover (35) with fuel pressure tube strut (31).

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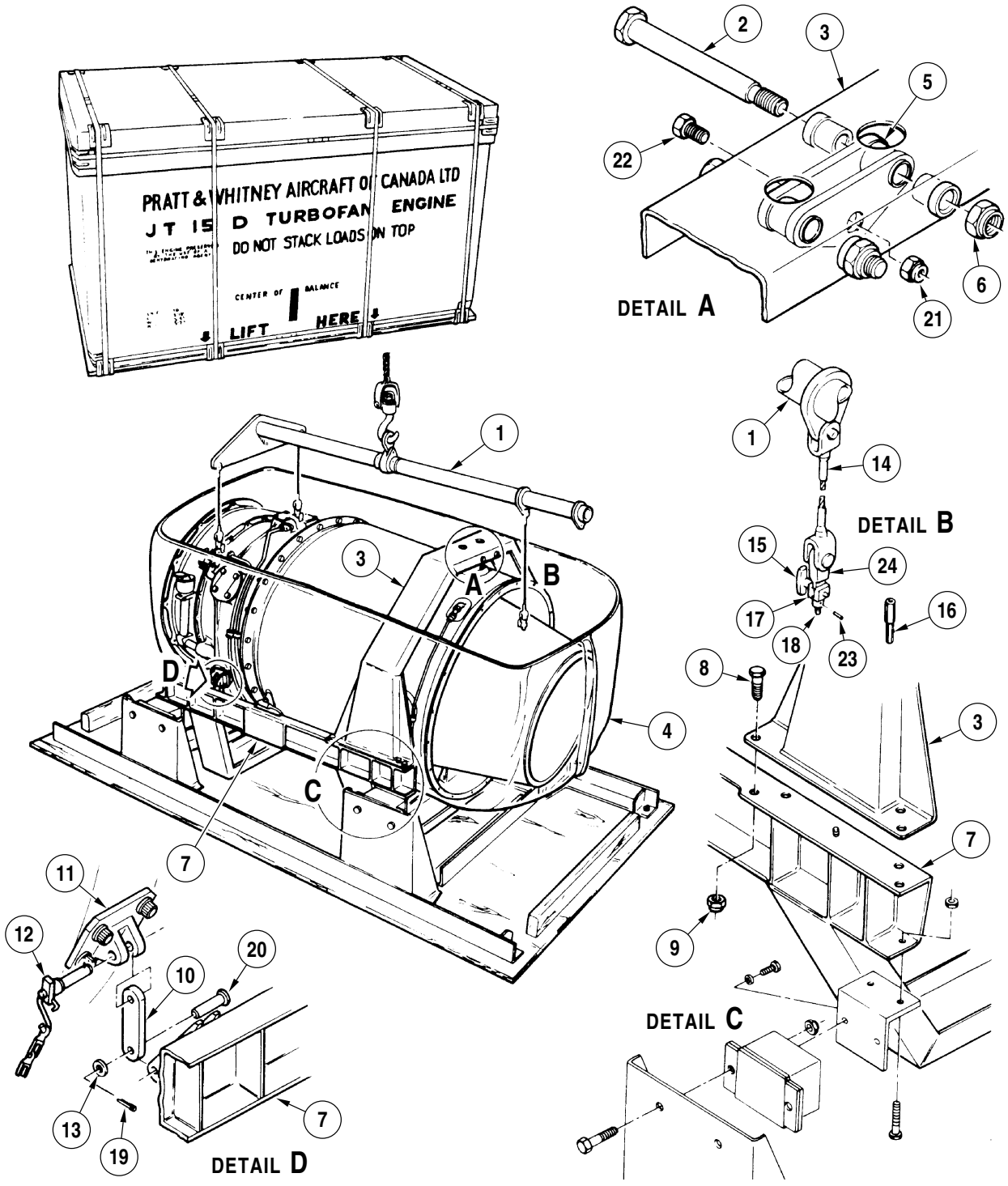

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Removal/Installation - Engine in Fiberboard Container
Figure 303

Key to Figure 303

1. Sling
2. Bolt
3. Rear Support
4. Protective Envelope
5. Rear Mount Bracket
6. Nuts (2 off)
7. Cradle
8. Bolt
9. Nut
10. Support
11. Front Lower Mount Bracket
12. Quick-release Pin
13. Washer
14. Cable Assembly
15. Pin
16. Hex Head Driver
17. Bracket Assembly
18. Socket Head Capscrew
19. Cotterpin
20. Pin
21. Nut
22. Bolt
23. Dowel Pin
24. Adapter

(b) Remove nut (38), bolt (36) and loop clamp (37) and remove loop clamp (37) from attached fuel pressure to cooler tube (39). Remove fuel pressure tube strut (31).

F. Installation of Engine into Shipping Container

CAUTION: ENSURE THAT OIL HAS BEEN COMPLETELY DRAINED FROM ENGINE.

(1) Preparation

(a) With engine mounted in stand (Ref. Para. 6.A.) and engine preservation procedures having been carried out (Ref. Para. 6.), install all blanking plates, plugs and caps (Ref. Illustrated Parts Catalog Part No. 3033442).

(b) For Post-SB7477: Install the fuel pressure tube support strut (31) for the fuel pressure to cooler tube (39) to fan case before installing engine into shipping container as follows:

1 Remove bolt (36), nut (38) and washer (3) to remove fuel pressure tube strut (31) from the fan case.

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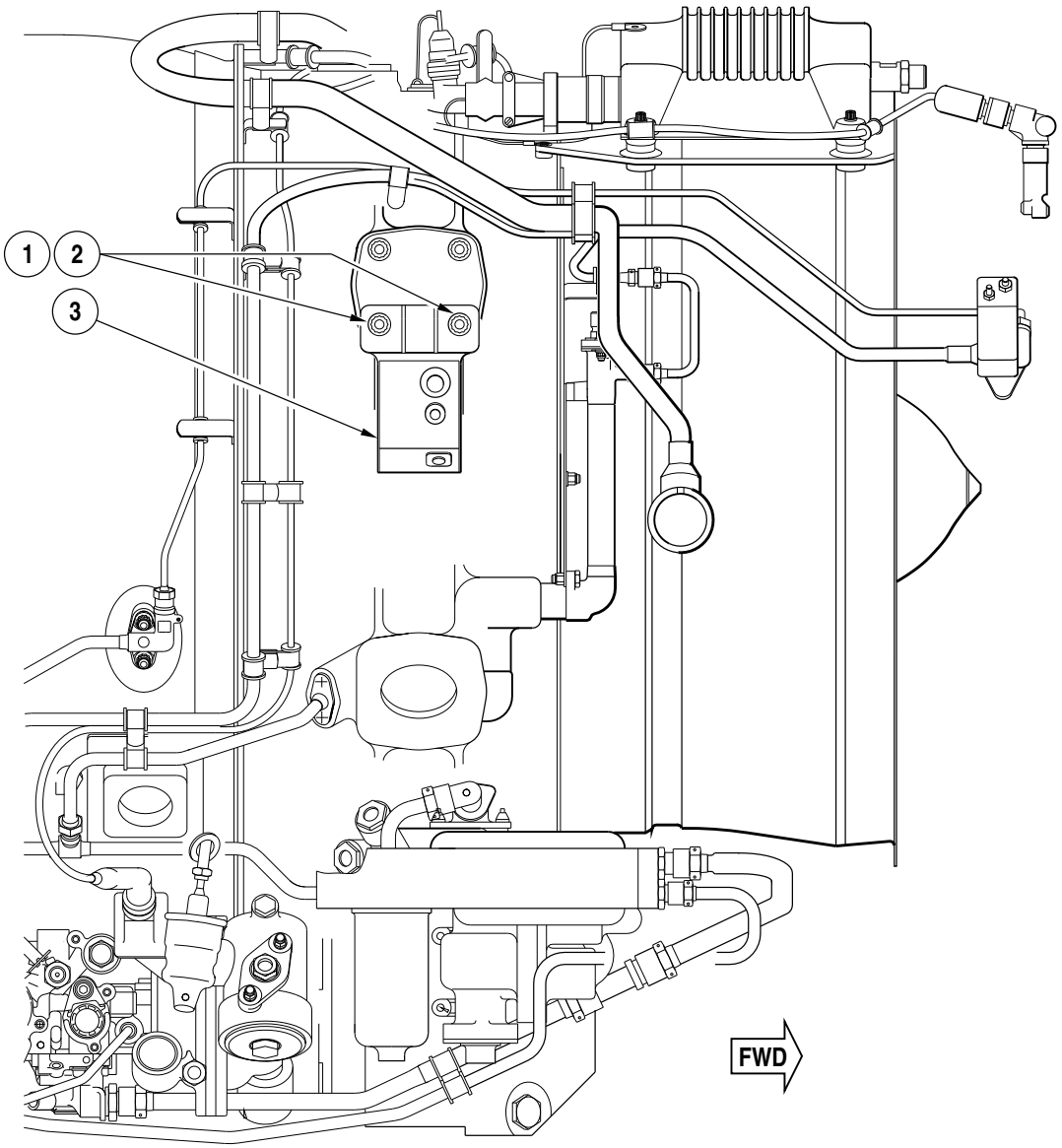

POST–SB7596 (BS713)

JT15D-5 (POST-SB7596) SHOWN, JT15D-5R SIMILAR C97296

Removal/Installation - Engine in Fiberboard Container
Figure 304

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Key to Figure 304

1. Bolt
2. Washer
3. Remote Oil Indicator Panel

2 Install fuel pressure tube strut (31) with bolt (32), washer (33) and nut (34) to attach the engine shipping nose cover (35) with fan case.

3 Install fuel pressure tube strut (31) on the fuel pressure to cooler tube (39) with loop clamp (37), bolt (36) and nut (38). Torque bolt (36) 36 to 40 lb. in.

(c) Ensure engine rear mount is installed in top center position (Ref. Removal/Installation).

(d) Ensure that cradle and skid base are serviceable and that a new or serviceable fiberboard sleeve and lid are available.

(e) Remove engine from stand (Ref. Para. 6.B.).

(2) Procedure

CAUTION: DO NOT USE STANDARD COMMERCIAL HARDWARE TO SECURE ENGINE SUPPORT BRACKETS TO ENGINE OR CONTAINER. USE OF HARDWARE OF LOWER STRENGTH THAN SPECIFIED COULD CAUSE SERIOUS ENGINE DAMAGE DURING SHIPPING.

(a) With engine suspended on sling (1), install mount bracket (5) on eye of mount strut at rear of engine with cap screw and self-locking nut. Tighten and torque nut 675 to 750 lb.in.

(b) Position rear support (3) over engine, taking particular care not to strike any part of engine. Secure rear support to rear mount bracket (5), with bolts (2), and self-locking nuts (6). Tighten nuts and torque to 135 to 150 lb.in.

(c) Ensure interior of protective envelope (4) is absolutely clean, then position envelope around engine so that gaskets are aligned with respective mounting pads and rear support.

(d) Attach engine front lower mount brackets (11) to engine mount pads on each side of intermediate casing with eight bolts. Align gaskets between pads and brackets, tighten bolts and torque to 275 to 300 lb.in., then lockwire.

(e) Secure humidity indicator (8, Fig. 302) to protective envelope (7). Ensure correct positioning for sighting through fiberboard sleeve window.

(f) Lower engine into cradle (7, Fig. 303). Align mounting holes in gaskets, rear support (3) and cradle. Align links on cradle (7) with front lower mount brackets (11). Check for adequate clearance between cradle and anti-icing air pressure tube elbow.

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(g) Secure engine to cradle (7) with pins (12), washers (13) and cotterpins (19) at front lower mount brackets (11), and bolt nuts. Torque 275 to 300 lb.in, and lockwire.

(h) Remove sling (PWC31503)and hoist from engine.

(i) Install the remote oil indicator panel (3, Figure 304) on right-hand upper mount pad of intermediate case with panel slot holes aligned with top holes in mount pad. Attach the panel to the mount pad with two bolts (1) and washers (2). Torque the bolts 225 to 300 lbf.in. and install the safety wire on the bolt.

(j) Place engine log book, log sheets and other relevant papers to be shipped with engine, in a waterproof envelope and seal with pressure sensitive tape (PWC05-070).

(k) Tie 12 (eight unit) freshly activated desiccant bags (PWC15-001)to engine, evenly disposed over engine length, six on each side.

(l) Remove desiccant bags (PWC15-001) from protective envelopes before installation. Refer to Figure 302, as required, for remaining procedures.

(m) Heat seal along top of envelope, using suitable hand sealing iron, leaving one corner open to evacuate air. Evacuate air, fold corner and heat seal.

(n) Install fiberboard sleeve (5, Figure 302), over engine and fit in position on skid base (6).

(o) Fold engine envelope and ensure humidity indicator (8) aligns with window in sleeve. Tape envelope folds with pressure sensitive tape (PWC05-070).

(p) Close flaps of sleeve and seal with pressure sensitive tape (PWC05-070).

(q) Place cover (3) on sleeve, fold flaps down and seal at each corner with pressure sensitive tape (PWC05-070).

(r) Secure cover horizontally with strap (1) (PWC05-063) and four metal reinforcing corners (2).

(s) Secure cover and sleeve to skid base with four steel straps (1) and 16 metal reinforcing corners (2).

(t) Mark engine model, serial number, and other pertinent preservation and inspection data on both ends of container, as required.

7. Engine Preservation and Depreservation

A. Engine Preservation Recommendations

(1) **The engine preservation requirements in Para. B., Engine Preservation Schedule, Para. C., Application of Corrosion-Inhibiting Compound to Engine External Areas, Para. D., Preservation of Engine Fuel System, and Para. E., Preservation of Engine Oil System are highly recommended.**

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(2) **If for any reason engine preservation requirements are not carried out, the circumstances and condition of such an engine will have to be reviewed by P&WC's JT15D Service Engineering Department to determine an inspection workscope required before the engine may be safely returned to service.**

(3) **Depending on the time duration, the environment and the condition in which the engine has been left unpreserved, the resulting field level inspection workscope may be relatively short for an engine left unpreserved for a short duration in a mild environment. However, if the engine was unpreserved for a long duration in a questionable environment, the inspection workscope could be longer, such that a shop visit is required to complete the inspection. Furthermore, the development of a lengthy, complex workscope may result in an additional charge to the operator for labour related to Service Engineering's review of an unpreserved engine, over and above any shop-related charges.**

B. Engine Preservation Schedule

(1) The procedure to be followed for the preservation of engines in service depends on the period of inactivity and whether or not the engine may be rotated during the inactive period. The expected period of inactivity should be established and reference made to the Engine Preservation Schedule (Ref. step (4)). The preservation carried out should be recorded in the engine log book and on tags secured to the engine.

(2) If the engine has operated in a salt-laden environment, do a compressor desalination motoring wash (Ref. 71-00-00, POWER PLANT - CLEANING) before any of the preservation procedures.

(3) If engines have to be stored for more than 90 days regardless of the environment, do a desalination wash.

(4) The following engine preservation schedule is to be followed:

TABLE 302, Preservation Schedule

Duration (Days)	Install Engine Covers or Seal Engine (Ref. Note 1)	Maintain Relative Humidity < 40 %	Preserve Fuel System	Drain Oil	Apply Corrosion Inhibiting Compound to Engine Externals	Desalination Wash
1 - 7 Days	COVERS	NO	NO	NO	NO	NO
8 - 28 Days	SEALED	YES	NO	NO	NO	NO (See Note 2)
29 - 90 Days	SEALED	YES	YES	NO	NO	YES (See Note 3)

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TABLE 302, Preservation Schedule (Cont'd)

Duration (Days)	Install Engine Covers or Seal Engine (Ref. Note 1)	Maintain Relative Humidity < 40 %	Preserve Fuel System	Drain Oil	Apply Corrosion Inhibiting Compound to Engine Externals	Desalination Wash
91 Days and over	SEALED	YES	YES	YES	YES	YES

NOTE 1. The cowl drain hole must not be left clogged.

NOTE 2. If humidity is below 40%, a desalination wash is recommended but not required.

NOTE 3. Applicable if engine has been exposed to a salt laden environment and not subsequently washed.

CAUTION: UNDER NO CIRCUMSTANCES SHOULD PRESERVATIVE OIL BE SPRAYED INTO COMPRESSOR OR TURBINE ENDS OF ENGINES. DIRT PARTICLES DEPOSITED ON BLADES AND VANES COULD ADHERE AND ALTER THE AIRFOIL SHAPE, ADVERSELY AFFECTING ENGINE EFFICIENCY.

(a) 1 to 7 days - Engines may be left in an inactive state, with no preservation protection, provided: engine is sheltered; humidity is not excessively high; engine is not subjected to extreme temperature changes which would produce condensation.

(b) 8 to 28 days - Engines inactive for up to 28 days, require no preservation provided all engine openings are sealed off and relative humidity in engine is maintained at less than 40 percent. Humidity control is maintained by placing desiccant bags and humidity indicator on wooden racks in engine exhaust duct. Suitable windows must be provided in exhaust closure to facilitate observation of humidity indicators.

(c) 29 to 90 days - Engines inactive for more than 28 days, but less than 90 days, need only have fuel system preserved (Ref. Subpara. D., Preservation of Engine Fuel System), engine intake and exhaust openings covered, and desiccant bags and humidity indicators installed.

(d) 91 days and over - Do the following to engines inactive over 91 days in airframe or removed for long-term storage in container:

1 Do the preservation procedures per 0 to 90 days schedule, above.

2 Drain the engine oil system (Ref. Subpara. E., Preservation of Engine Oil System).

3 Spray new accessory drive pads (Ref. Subpara. E., Preservation of Engine Oil System).

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4 Apply corrosion inhibiting compound to defined engine external areas per Subpara. C.

C. Application of Corrosion-Inhibiting Compound to Engine External Areas

NOTE: The following procedure is applicable to JT15D engines in long-term storage as defined in Subpara. B.

CAUTION: REFER TO THE MANUFACTURER'S INSTRUCTIONS FOR DETAILED TECHNICAL PROCEDURES AND THE MATERIAL SAFETY DATA SHEET.

CAUTION: DO NOT APPLY CORROSION INHIBITORS (PWC15-011) OR (PWC15-015) ON ENGINE COMPONENT ELECTRICAL CONNECTORS, ON THE ENGINE EEC, ON ENGINE CABLES AND PROBES OR ON RUBBER MATERIAL.

(1) Apply anti-corrosion inhibitor (PWC15-011) or (PWC15-015) using a brush to the following engine external surfaces in accordance with the product manufacturer's instructions:

- Engine intermediate case up to and including the rear flange (Flange B)
- Accessory gearbox and AGB cover
- Engine oil pump

D. Preservation of Engine Fuel System

CAUTION: UNDER NO CIRCUMSTANCES SPRAY ENGINE PRESERVATION OIL INTO COMPRESSOR OR TURBINE ENDS OF ENGINE. DIRT PARTICLES DEPOSITED ON BLADES AND VANES DURING SUCH AN OPERATION WILL ALTER AIRFOIL SHAPES AND ADVERSELY AFFECT ENGINE EFFICIENCY.

CAUTION: EXTREME CARE MUST BE TAKEN TO PREVENT FOREIGN MATERIAL FROM BEING DRAWN INTO ENGINE FUEL SYSTEM. EQUIPMENT MUST BE SUPPLIED WITH SUITABLE FILTERS NO COARSER THAN 10 MICRON RATING.

(1) Carry out preservation of engine fuel system on engines inactive more than 28 days as follows:

NOTE: Sufficient information is contained in the following procedures to preserve the fuel system of an installed or uninstalled engine. For uninstalled engines, accomplish engine rotation by manually cranking HP rotor through starter-generator pad using wrench (PWC31540).

(a) Close airframe fuel supply and disconnect fuel inlet to fuel pump (Ref. Airframe Maintenance Manual).

NOTE: On engines equipped with a motive flow valve, disconnect the airframe motive flow valve line at engine motive flow valve and seal valve and line with suitable blanking caps.

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(b) Disconnect bypass fuel line from flow divider valve to HMU (Ref. 73-10-09). Install cap on flow divider valve bypass elbow .

(c) Disconnect and remove primary and secondary fuel tubes leading from flow divider valve to fuel manifold (Ref. 73-10-09). Seal off fuel manifold elbow connectors.

(d) Connect suitable preservative oil supply line at fuel pump inlet (Ref. Airframe Maintenance Manual). Inject preservative oil (PWC05-077) at pressure of 5 to 25 psi and at a temperature of at least 16°C (60°F).

CAUTION: OBSERVE STARTER MOTOR OPERATING LIMITS (REF. STARTER MANUFACTURER'S MANUAL).

(e) With ignition system OFF and power control lever in IDLE position, carry out a 30-second motoring run using engine electric starter (Ref. 71-00-00, ADJUSTMENT/TEST, Ground Testing) . Ensure that preservative oil pours from open fuel system primary connection. During motoring run, power control lever should be moved from IDLE to CUTOFF and back to IDLE, to ensure that preservative oil is passed through bypass section of flow divider valve.

CAUTION: OBSERVE STARTER MOTOR OPERATING LIMITS (REF. STARTER MANUFACTURER'S MANUAL).

(f) Seal off primary and bypass connections on flow divider valve and carry out a second motoring run with power control lever remaining in IDLE position. Check that preservative oil now pours from open secondary fuel connection on flow divider valve.

(g) On completion of motoring runs, disconnect and remove preservative oil supply, remove sealing caps from primary and bypass fuel connections on flow divider valve and reconnect all disconnected lines.

NOTE: On engines equipped with a motive flow valve, remove the blanking caps from the motive flow valve and airframe motive flow valve flow line. Connect line (Ref. Airframe Maintenance Manual).

(h) Install all plugs, caps and covers, as required, to prevent entry of foreign material and accumulation of moisture (Ref. Illustrated Parts Catalog Part No. 3033444).

(i) Tag engine and power control lever in aircraft cabin, as applicable, with a warning prohibiting cranking of engine and include date of preservation of engine.

E. Preservation of Engine Oil System

(1) Carry out preservation of engine oil system (engines inactive for periods exceeding 90 days) as follows:

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(a) Place suitable drip pan under engine, remove oil filler cap, oil drain plugs and JT15D-5 (Post-SB7599) chip detector, as applicable (Ref. Subpara. 5.G.).

NOTE: The engine oil may be expected to be free flowing at temperatures down to -29°C (-20°F); however, when engine is not running engine oil viscosity is a function of ambient temperature and time. Prior to draining oil, remove dipstick and check oil viscosity. If the oil is not free flowing, carry out a 10-minute engine run (Ref. 71-00-00, ADJUSTMENT/TEST).

(b) Allow oil to drain to a slow drip (approximately one-half hour).

(c) Remove cover plates from unused accessory drive ends, and spray exposed surfaces and gearshafts with engine lubricating oil (PWC03-001). Replace cover plates.

(d) Seal all openings to prevent entry of foreign material and accumulation of moisture.

NOTE: If engine is to remain in aircraft, place bags of desiccant (PWC15-001) on wooden racks in inlet and exhaust ducts.

(e) Install new preformed packings on oil drain plugs and install drain plugs at respective locations (Ref. Subpara. 5.H.). Install oil filler cap.

(f) Tag oil filler cap with date of preservation and enter date and type of preservation in engine log book.

(g) Install humidity indicator (PWC15-002) in air inlet end and in exhaust end of engine compartment. Cover with suitable airtight moisture barrier. Provide inspection windows at each end for observation of humidity indicators.

NOTE: Inspection of a preserved unit should be carried out every two weeks if the aircraft is stored outside, or every 30 days if the aircraft is stored inside. If the relative humidity indicated by the humidity indicator is less than 40 percent, no further action is required. If humidity indicated exceeds 40 percent, the desiccant bags must be replaced by freshly activated desiccant bags.

F. Engine Depreservation Schedule

(1) The following procedures are to be followed:

(a) 0 to 7 days - No depreservation required.

(b) 8 to 28 days - Desiccant and moisture barriers must be removed. Ensure that all previously sealed engine openings are reopened and are unobstructed.

(c) 29 to 90 days - Remove engine intake and exhaust covers together with desiccant and humidity indicators. Depreserve engine fuel system.

(d) 91 days and over - Engine must be completely depreserved and lubrication system serviced.

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(e) If third generation oil was used, replace all AGB accessory pad seals.

G. Depreservation of Engine Oil System

(1) Fill engine oil tank with approved oil (Ref. Subpara. 5.H.).

NOTE: The engine oil system does not require any further depreservation procedures.

H. Depreservation of Engine Fuel System

(1) Connect aircraft fuel supply.

NOTE: On engines equipped with a motive flow valve, disconnect the airframe motive flow valve line at flow valve and seal off valve and line with suitable blanking caps.

(2) Disconnect fuel bypass line between flow divider valve and fuel control unit at flow divider valve (Ref. 73-10-09).

(3) Disconnect primary and secondary fuel tubes to manifold at flow divider valve (Ref. 73-10-09).

(4) With ignition system OFF, remove preservative oil from fuel system as follows:

(a) Place power control lever at IDLE position.

CAUTION: OBSERVE STARTER MOTOR OPERATING LIMITS (REFER TO STARTER MANUFACTURER'S MANUAL).

(b) Perform a 30-second wet motoring run (Ref. 71-00-00, ADJUSTMENT/TEST, Ground Testing) and check that fuel pours from open primary connection on flow divider valve. During motoring run, move power control lever from IDLE to CUT OFF position, then back to IDLE to ensure fuel purging of flow divider bypass section.

(c) Seal off primary and bypass connections on flow divider valve.

(d) Perform a second 30-second wet motoring cycle with power control lever at IDLE and check that fuel pours from open secondary fuel connection on flow divider valve.

(e) Reconnect all fuel tubes at flow divider valve. Tighten coupling nuts on primary and bypass fuel tubes and torque 90 to 100 lb.in. Tighten coupling nuts on secondary fuel tube to 270 to 300 lb.in. Lockwire all couplings.

NOTE: 1. On engines equipped with a motive flow valve, remove the blanking caps from the motive flow valve and airframe motive valve flow line. Connect motive flow valve line (Ref. Airframe Maintenance Manual).

NOTE: 2. Visually inspect all fuel system lines and connections for safety and security.

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I. Regular Operation as an Alternative to the Preservation of Engines

(1) For engines installed on aircraft, running the engine once a week is an acceptable alternative to avoid preservation procedures mentioned in Para.7. B. This prevents stagnation of fuel in the fuel system, reduces humidity and condensation accumulation in the oil system.

(2) Do a 30 minute engine run, start with five minutes at idle followed by five minutes at T/O power, 15 minutes at T/O - 5% and ending with five minutes at idle. Check for oil leaks and oil consumption. Make sure that the oil temperature has reached 70 °C minimum during the engine run.

8. Removal/Installation of Engine from/into Maintenance Stand

A. Installation of Engine in Stand (Ref. Fig. 305)

CAUTION: ENSURE THAT STAND WHEELS AND HAND WHEEL ON STAND GEARBOX ARE LOCKED.

(1) Position stand (PWC31000) directly under engine. Ensure that stand wheels and hand wheel on stand gearbox are all locked.

(2) Remove mount pad covers, if installed, from upper mount pads on engine intermediate case.

(3) Loosen bolts securing lower support brackets (5) to frame on stand.

(4) Pivot front struts (1) outward at top of stand frame.

CAUTION: DO NOT ALLOW ENGINE TO CONTACT ANY PART OF ENGINE STAND WHEN LOWERING.

(5) Lower engine into stand (PWC31000), mating engine lower mount pads with lower support brackets (5). Loosely secure brackets to mount pads with eight bolts. Tighten nuts securing brackets to frame of stand and torque to 250 to 270 lb.in. Torque bolts at engine mount pads 275 to 300 lb.in.

(6) Remove mount brackets (3) from front struts (1) by removing lockpins (2).

(7) Install mount brackets (3) on engine upper mount pads with eight bolts. Tighten bolts and torque to 275 to 300 lb.in.

(8) Adjust lengths of front struts (1) as necessary, and secure to mount brackets (3) with lockpins (2). Tighten strut locknuts.

(9) Remove sling (PWC31503) and hoist from engine.

(10) If stand-mounted engine is to be moved more than a few feet, make engine more stable in stand by securing each bracket of rear struts (4) to flange of bypass duct with three screws, washers and nuts. Tighten nuts and torque to 32 to 36 lb.in.

NOTE: Rear struts must be removed to enable rotation of engine in stand.

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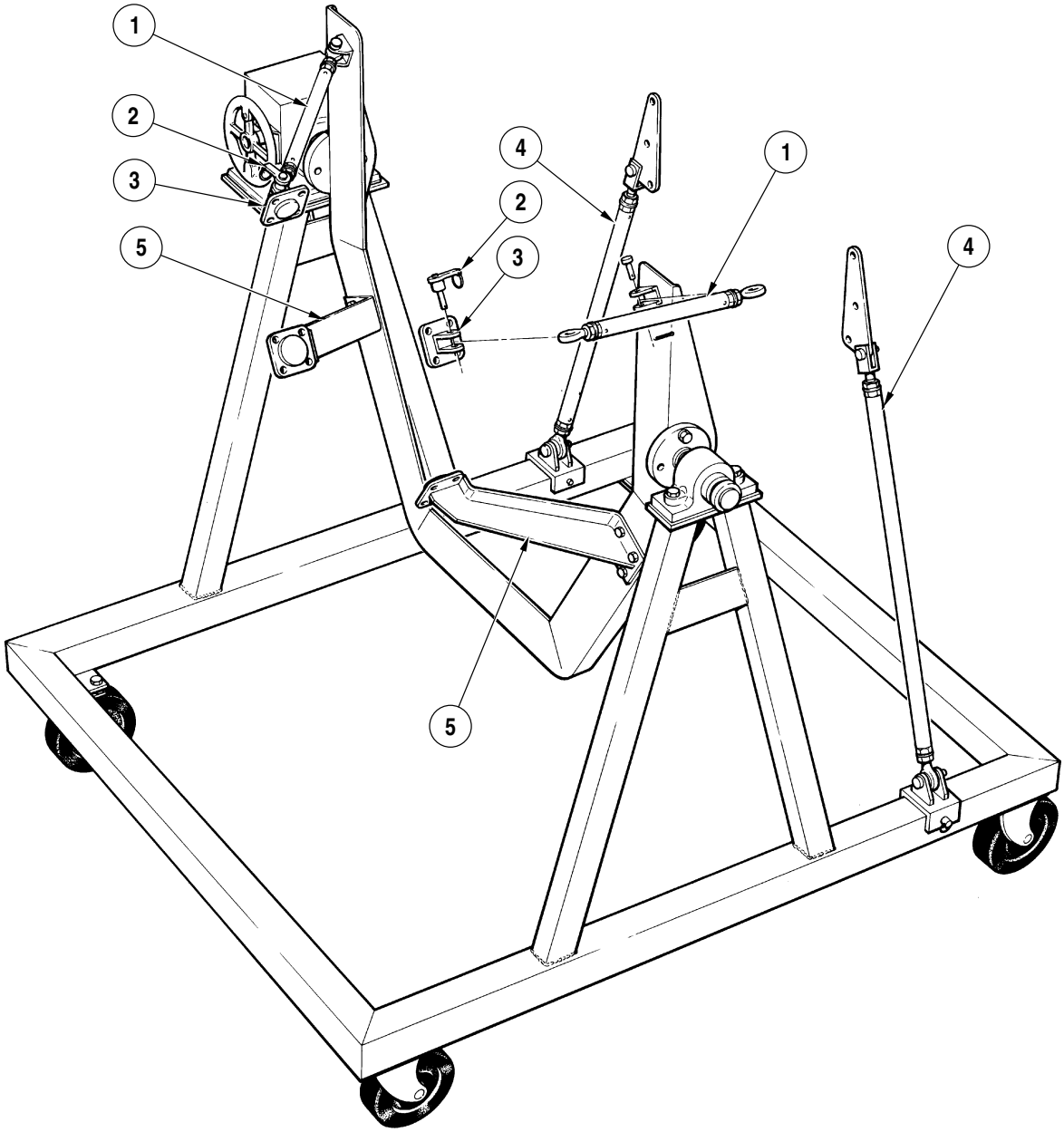

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Engine Stand - Heavy Maintenance
Figure 305

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Key to Figure 305

1. Front Strut
2. Lockpin
3. Mount Bracket
4. Rear Strut
5. Low Support Bracket

B. Removal of Engine from Stand (Ref. Figs. 303 and 305)

CAUTION: WHEN AN ENGINE IS TO BE REMOVED FROM AN ENGINE STAND, ENSURE THAT A HOIST OF SUFFICIENT LIFTING CAPACITY AND SAFETY FACTOR IS AVAILABLE (REF. SUBPARA. 6.D., PRECEDING).

(1) Ensure engine and maintenance stand (PWC31000) are directly beneath hoist.

(2) Ensure a clear overhead space of at least eight feet (2.44 meters) is available, not including distance from top of engine to hoist hook.

(3) Lock transport wheels and gearbox hand wheel on maintenance stand (PWC31000).

(4) Install sling (PWC31503)(1, Fig. 303):

(a) Secure front wire rope supports to two lifting brackets on rear flange of LP compressor case.

(b) Insert socket-headed capscrew (18) in bracket (17) and install assembly in boss on turbine exhaust duct. Tighten and torque capscrew 150 lb.in. using hexagon head driver (16).

(c) Install dowel pin (23) in bracket (17). Align cable assembly (14) over exhaust duct and secure adapter (24) to bracket (17) using pin (15).

(5) Adjust lifting eye on sling (1) to ensure horizontal lift.

(6) Take weight of engine on sling. Remove attachment brackets on rear struts (4, Fig. 305) from engine bypass duct rear flange.

(7) Loosen locknuts on front struts (1), remove lockpins (2) and pivot struts outwards.

(8) Remove mount brackets (3) from two upper engine mounting pads.

(9) Loosen lower support brackets (5) at stand frame, then remove from engine mounting pads.

CAUTION: DO NOT ALLOW ENGINE TO REMAIN SUSPENDED FROM HOIST LONGER THAN NECESSARY.

(10) Carefully hoist engine from stand.

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9. Inhibition of Engine Corrosion

A. General

JT15D engines operating in a salt-laden atmosphere, regions where industrial pollution is present or other harsh conditions are subject to superficial to extreme corrosion. In these harsh conditions, corrosion tends to be most observed on the engine intermediate case. External and internal engine corrosion is inhibited by the regular use of engine corrosion inhibiting compounds and reduced engine desalination wash frequency.

B. Recommended Procedures for External and Internal Engine Corrosion Inhibition

Do procedures for external and internal engine corrosion inhibition in 71-00-00, CLEANING.

C. Recommended Procedures for Engine Corrosion Inhibition During Long-term Storage

Procedures for applying corrosion-inhibiting compounds on an engine in applicable long-term storage interval are found in Subpara. B.

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ENGINE: TURBINE - REMOVAL/INSTALLATION

1. General

   A. The following are procedures for preparing the engine for removal from and installation on the airframe, and for converting an engine from the shipping container to a right-handed configuration.

2. Consumable Materials

   Not Applicable

3. Special Tools

   The special tools listed below are used in the following procedures.

Tool No.	Name
PWC31000	Maintenance Stand
PWC30128-07	Puller, Oil Filler Tube Blanking Plug
PWC31260	Extractor, Engine Rear Mounting Bolt (Pre-SB7322)
PWC31262	Puller, Engine Rear Mounting Bolt (Pre-SB7322)
PWC31503	Engine Lifting Sling
PWC31772	Puller , Cabin Air Bleed Transfer Tube (replaces PWC31272)

4. Fixtures, Equipment and Supplier Tools

   The fixtures, equipment and supplier tools listed below are used in the following procedures.

Name	Remarks
Engine Hoist	Minimum 1025 lb. (466 kg) capacity

5. Removal of Engine from Airframe

   A. General

      An engine removed from airframe must be correctly installed in maintenance stand (Ref. SERVICING) prior to heavy maintenance, opposite side conversion, or return to an approved overhaul facility.

   B. Procedure

      (1) If required, preserve engine fuel system and engine oil system while engine is on airframe (Ref. SERVICING). If engine oil system is not preserved, drain engine oil until it is below level of oil transfer tube which joins oil filler neck at intermediate case.

      CAUTION: IF ENGINE IS DROPPED, RETURN IT TO AN APPROVED OVERHAUL FACILITY.

      (2) Remove engine from airframe using sling (PWC31503) in accordance with procedures in Airframe Maintenance Manual. For installation of sling, refer to SERVICING.

(3) While engine is in sling, remove upper and lower mount pad covers installed on right or left-hand side of engine (Ref. Subpara. 6.B.).

(4) Install engine on maintenance stand (PWC31000) (Ref. SERVICING).

C. Disposition of Engine Following Removal from Airframe and Installation in Maintenance Stand

(1) Heavy Maintenance: proceed with desired heavy maintenance procedures.

(2) Preparation for Return to Overhaul Facility:

(a) Prepare engine for installation in shipping container. Reposition engine rear mount from side-mount location to top-mount location (Ref. Para. 6., following).

(b) Preserve engine fuel and oil systems if this was not done with engine on airframe (Ref. SERVICING).

(c) Install engine in shipping container (Ref. SERVICING).

(3) Converting the Engine for Installation on Opposite Side of the Aircraft:

(a) Reposition engine rear mount to location 180 degrees opposite (Ref. Para. 6.C., following).

(b) For JT15D-5 (Post-SB7596) and JT15D-5R engines: remove and relocate the remote oil level panel indicator (Ref. 79-30-02, MAINTENANCE PRACTICES)

(c) Remove and relocate the oil filler neck and support plate to the opposite side of the engine (Ref. Para. 6.).

(d) For JT15D-5 (Post-SB7596) and JT15D-5R engines: remove and relocate the remote oil level indicator and housing assembly to the opposite side of the engine (Ref. 79-30-03, MAINTENANCE PRACTICES).

(e) For JT15D-5 (Post-SB7596) and JT15D-5R engines: remove and relocate the remote oil level indicator vent tubes to the opposite side of the engine (Ref. 79-30-04, MAINTENANCE PRACTICES).

(f) For JT15D-5 (Post-SB7596) engines: remove and reposition the engine chip detector cable onto the opposite side of the engine (Ref. 79-30-05, MAINTENANCE PRACTICES).

(g) For JT15D-5R engines: remove and reposition the fuel filter and bracket to the opposite side of the engine (Ref. 73-10-13).

NOTE: The bracket for the left side of the engine is not the same bracket as the right side. The fuel tubes and some of the mounting hardware are also different (Ref. 73-10-01).

(h) Remove and reposition the engine electrical wiring harness onto the opposite side of engine (Ref. 73-20-04, MAINTENANCE PRACTICES).

(i) Remove and relocate the engine front mount pad covers .

(j) Remove and relocate the engine cabin bleed air port (Ref. Subpara. 6.E.).

6. Preparation of Engine Removed from or Installed in Airframe

A. General

CAUTION: ALL REMOVAL AND REPLACEMENT OF COMPONENTS AND ACCESSORIES MUST BE CARRIED OUT WITH THE ENGINE MAINTAINED IN THE HORIZONTAL ATTITUDE.

(1) The engine is designed to be installed in a right- or left-hand side-mounted airframe nacelle, or in an underslung airframe nacelle. For this reason, the strut-supported engine rear mount can be installed at the 12 o'clock, 3 o'clock and 9 o'clock positions. The top center location is used for installation in the shipping container.

(2) Current engine installations are side mounted, and the engine rear mount requires relocation to the left or right before being installed in the airframe.

(3) Except for top-mounted engine rear mount, new engines, or engines returning from an approved overhaul facility are built and shipped as left-hand engines. Convert left-hand engine from shipping container to right-hand engine in maintenance stand (Ref. Subpara. C.).

B. Preparation of Front Mount Pads

NOTE: As shipped, both upper front mount pads are protected by covers.

(1) With engine supported by hoist, remove front upper cover from side of engine which is to be attached to aircraft and reinstall same cover in front lower position on opposite side of engine.

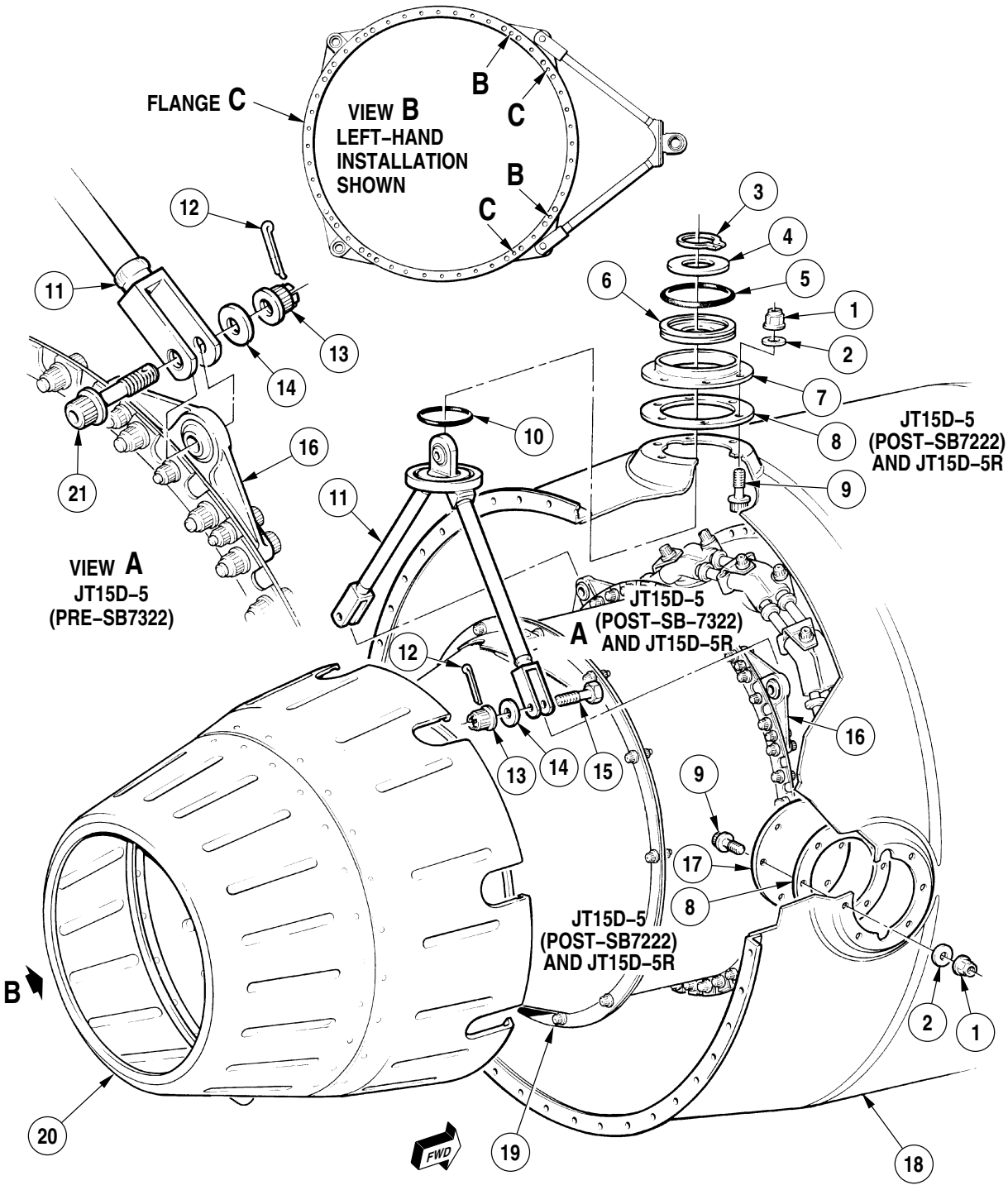
(2) Install airframe mount brackets on two exposed front mounting pads (Ref. Airframe Maintenance Manual).

C. Preparation of Rear Engine Mount (Ref. Fig. 401)

(1) Remove six self-locking nuts (1), washers (2) and bolts (9) that retain cover plate (17) and gasket (8), JT15D-5 (Post-SB7222) and JT15D-5R, at position on engine which is to receive rear engine mount (11).

(2) Remove rear inner bypass duct (20) (Ref. 72-70-02).

NOTE: Use the following procedures to position the engine rear mount for installation in shipping container, or for converting engines for installation in opposite side of airframe. For removal of mount during engine heavy maintenance, refer to Chapter 72-70-04.



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Removal/Installation - Rear Engine Mount (Typical)
Figure 401

Key to Figure 401

1. Self-locking Nut
2. Washer
3. Retaining Ring
4. Seal Plate Retaining Ring
5. Preformed Packing
6. Rear Engine Mount Sealing Plate
7. Side Mount Flange
8. Gasket, JT15D-5 (Post-SB7222) and JT15D-5R
9. Bolt
10. Preformed Packing
11. Engine Rear Mount
12. Cotterpin
13. Castellated Nut
14. Washer
15. Bolt, JT15D-5 (Post-SB7322) and JT15D-5R
16. Rear Engine Mount Bracket
17. Cover Plate
18. Outer Bypass Duct
19. Exhaust Duct
20. Rear Inner Bypass Duct
21. Bolt, JT15D-5 (Pre-SB7322)

(3) Remove six self-locking nuts (1), washers (2) and bolts (9) securing side mount flange (7) and gasket (8), JT15D-5 (Post-SB7222) and JT15D-5R, to boss on outer bypass duct (18).

NOTE: Separate side mount flange from outer bypass duct as engine rear mount (11) is removed. Use of prying tool to separate flanged plate from outer bypass duct may damage duct.

CAUTION: HOLD BOLT WHILE LOOSENING CASTELLATED NUT. BOLT SHANK WILL BE DAMAGED IF NUT IS HELD WHILE BOLT LOOSENED.

(4) Remove two cotterpins (12) from castellated nuts (13). Hold bolts (15) and untorque castellated nuts. Remove nuts and washers (14).

(5) Using puller (PWC31262) and extractor (PWC31260), remove two JT15D-5 (Pre-SB7322) bolts (21). Remove two JT15D-5 (Post-SB7322) or JT15D-5R bolts (15) using soft-faced hammer and nonmetallic drift.

CAUTION: REMOVE ENGINE REAR MOUNT WITH CARE TO AVOID DAMAGING OUTER BYPASS DUCT SKIN.

(6) Lift engine rear mount (11) upward to separate side mount flange (7) from outer bypass duct (18). Remove side mount flange with sealing plate (6) and JT15D-5 (Post-SB7222) or JT15D-5Rgasket (8). Discard gasket.

(7) Separate side mount flange (7) and sealing plate (6). Remove and discard preformed packing (5) from sealing plate.

(8) Lift engine rear mount (11) so that struts enter two slots in boss on outer bypass duct (18). Rotate rear mount so that struts lift over LP turbine stator support flange, one at a time. Remove mount through rear of outer bypass duct.

(9) Remove preformed packing (10) from engine rear mount (11). Discard preformed packing.

(10) Install new preformed packing (10) on engine rear mount (11).

(11) Align spherical bearings on rear engine mount brackets (16) at location on engine which is to receive engine rear mount (11). Insert engine rear mount (11), rotate upward and lift struts into slots on outer bypass duct (18) side mount or top mount boss. Position fork ends of struts over spherical bearings on mount brackets.

CAUTION: CHECK THAT BOLTS ARE IN GOOD CONDITION.

(12) Install two JT15D-5 (Pre-SB7322) bolts (21) (bolt heads to rear of of engine mount) or two JT15D-5 (Post-SB7322) or JT15D-5R bolts (bolt heads forward of engine mount) with washers (14) and castellated nuts (13). Torque nuts 125 to 170 lb.in. and secure with new cotterpins (12).

(13) If JT15D-5 (Post-SB7222) or JT15D-5R engine, install new gasket (8). Install side mount flange (7). Secure to outer bypass duct (18) with six bolts (9), washers (2) and self-locking nuts (1). Torque nuts 36 to 40 lb.in.

(14) Install new preformed packing (5) on sealing plate (6) and install in top mount flange (7). Install seal plate retaining ring (4) and secure to engine rear mount (11) with retaining ring (3).

(15) If engine is being installed in airframe, secure to airframe with attachment hardware (Ref. Airframe Maintenance Manual).

(16) Install cover plate (17), with new gasket (8) if JT15D-5 (Post-SB7222) or JT15D-5R engine, in exposed mount position on outer bypass duct (18). Secure with six bolts (9), washers (2) and self-locking nuts (1). Torque nuts 36 to 40 lb.in.

(17) Refer to Chapter 72-70-04 for Fits and Clearances.

(18) Reinstall rear inner bypass duct (20) (Ref. 72-70-02).

D. Relocation of Oil Filler Neck (Ref. Fig. 402)

(1) If engine installation requires repositioning of oil filler neck to opposite side of engine, drain oil until it is below the level of the oil filler neck connection with the intermediate case (Ref. 72-00-00, SERVICING).

(2) Remove two self-locking nuts (11) which retain filler neck (12) at Flange A, and one self-locking nut (7) and bolt (10) securing filler neck to plate (8). Remove filler neck together with transfer tube (6) or ball valve assembly (4) from intermediate case boss. Remove and discard two preformed packings (5).

(3) Remove self-locking nut (9) securing plate (8) to intermediate case flange. Remove plate.

(4) Remove three self-locking nuts, one washer and two spacers from studs at corresponding filler neck location on opposite side of flange A. Install at alternative positions. Torque nuts 75 to 85 lb.in.

(5) Install two new preformed packings (5) on transfer tube (6) or oil filler ball valve (4), then insert transfer tube or ball valve into oil filler neck (12).

NOTE: For JT15D-5 (Pre-SB7415) engines, ensure integral oil strainer is securely in position. For JT15D-5 (Post-SB7415) and JT15D-5R engines, ensure ball end of oil filler ball valve assembly is installed in oil filler neck.

(6) Remove retaining ring (3). Use puller (PWC30128-07) to remove plug (2) from boss at alternative position on intermediate case. Discard with preformed packing (1).

(7) Secure plate (8) at alternative installation position on intermediate case flange with self-locking nut (9). Tighten and torque nut 75 to 85 lb.in.

(8) Insert open end of transfer tube (6) or ball valve (4) into open port in intermediate case from which plug (2) was removed. Secure plate (8) and oil filler neck (12) to two intermediate case studs using self-locking nuts (11). Torque flange nuts 75 to 85 lb.in.

(9) Secure outboard side of plate (8) to oil filler neck (12) with bolt (10) and nut (7). Torque bolt 85 to 95 lb.in.

(10) Install new preformed packing (1) on plug (2) and insert into boss vacated by transfer tube (6) or ball valve (4). Secure with retaining ring (3).

(11) Service with engine oil and check level (Ref. 72-00-00, SERVICING).

E. Installation Requirements for Cabin Bleed Air Transfer Tube (Ref. Fig. 403)

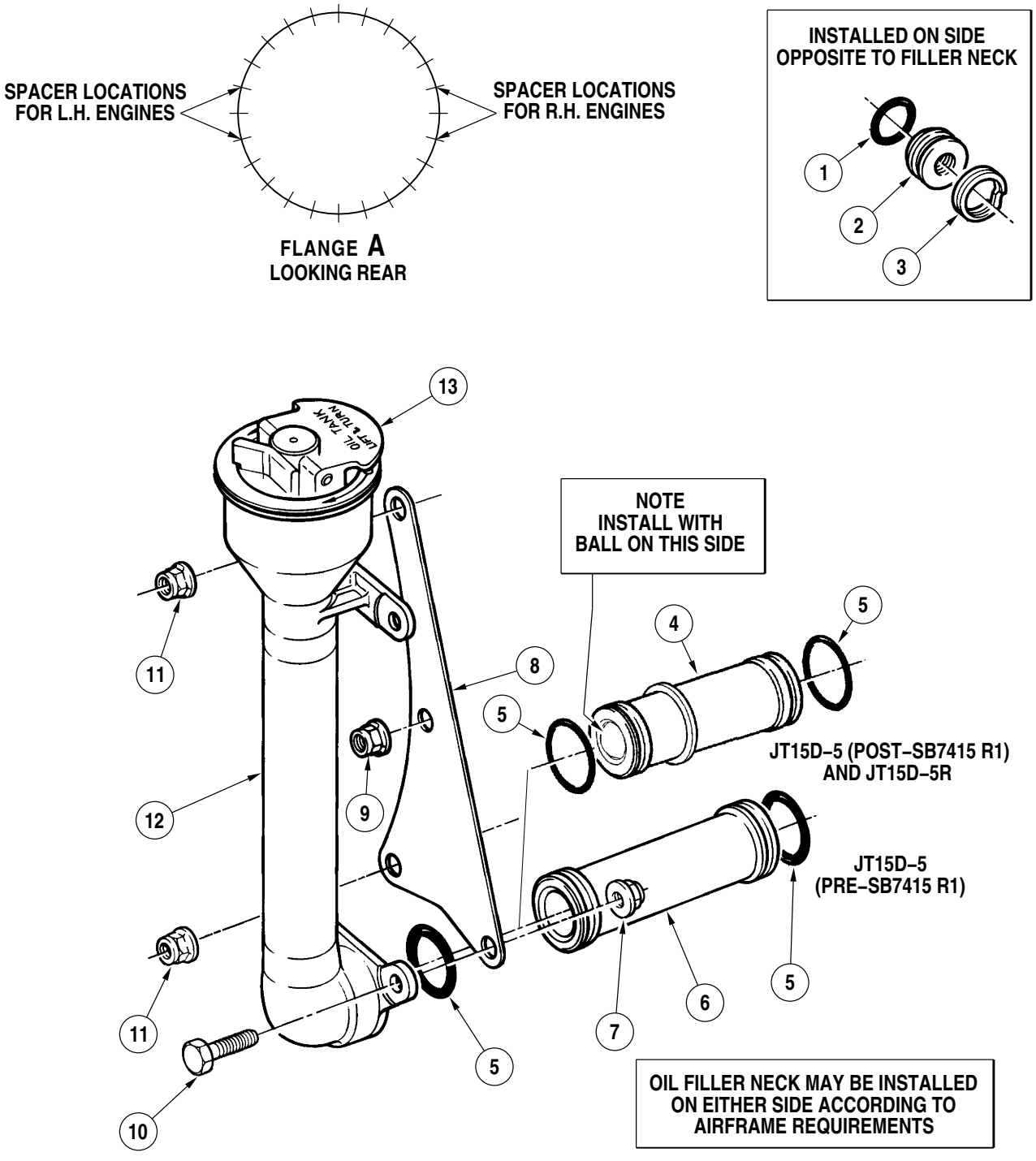
NOTE: Two cabin bleed air tubes are located at the front of the bypass duct, one on each side at the 4 and 8 o'clock positions, respectively. The standard tube draws five percent bleed air from the high pressure compressor delivery. Certain engine installations may require non-standard tubes.

(1) Refer to Airframe Maintenance Manual. Verify if five percent or nonstandard cabin air bleed tubes should be installed. If necessary, to change from five percent to nonstandard tubes, or vice-versa, proceed as follows:

(a) Remove four self-locking nuts (1) and washers (2) and remove blanking cover (3), gasket (4) and retaining ring (5).

(b) Remove transfer tube (7) using puller (PWC31772).

(c) Install new preformed packings (6) and (8) on tube (7) to be installed, and insert through bypass duct into gas generator case. Secure with retaining ring (5).



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Relocation of Oil Filler Neck
Figure 402

Key to Figure 402

1. Preformed Packing
2. Plug
3. Retaining Ring
4. Oil Filler Ball Valve Assembly, JT15D-5 (Post-SB7415) and JT15D-5R
5. Preformed Packing
6. Transfer Tube, JT15D-5 (Pre-SB7415)
7. Self-locking Nut
8. Plate
9. Self-locking Nut
10. Bolt
11. Self-locking Nut
12. Oil Filler Neck
13. Oil Filler Cap

(d) Check for condition of gasket (4) and replace, as necessary.

(e) Install cover (3) and secure with four washers (2) and nuts (1). Tighten nuts and torque to 65 to 75 lb.in.

(f) Repeat procedure on opposite side of engine.

7. Installation of Engine in Airframe

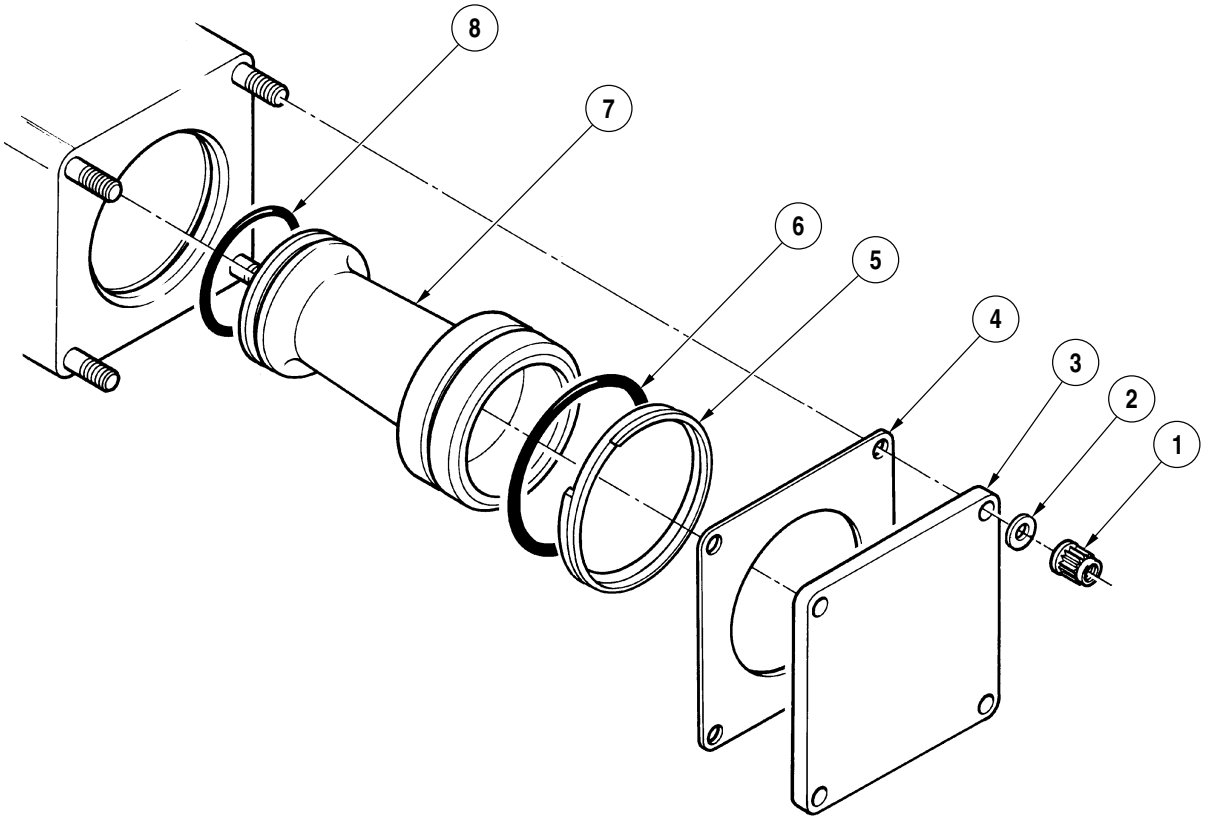
A. Procedure

CAUTION: IF ENGINE IS DROPPED, RETURN IT TO AN APPROVED OVERHAUL FACILITY.

(1) Refer to Servicing. Secure sling (PWC31503) to eye brackets at 10 o'clock and 2 o'clock positions, and through rear inner bypass duct to threaded boss on exhaust duct. Remove engine from maintenance stand (Ref. SERVICING).

(2) Install engine in airframe (Ref. Airframe Maintenance Manual).

(3) Perform required ground checks (Ref. 71-00-00, ADJUSTMENT/TEST).



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Removal/Installation of Cabin Bleed Air Transfer Tube
Figure 403

Key to Figure 403

1. Self-locking Nut
2. Washer
3. Blanking Cover
4. Gasket
5. Retaining Ring
6. Preformed Packing
7. Transfer Tube
8. Preformed Packing

ENGINE: TURBINE - INSPECTION

1. General

   A. Engine periodic, hot section and unscheduled inspection criteria are summarized on Tables 601 and 602, and Paragraph 9.. When applicable, component inspection procedures are found in the Inspection/Check sections of subject chapters in this manual. Modifications to inspection procedures will be included in later manual revisions.

   B. The DAILY/PREFLIGHT and MINOR periodic inspections in Table 601 are considered to be minimum inspection and maintenance requirements. Where possible, inspections in the MINOR column align with scheduled airframe checks (maintenance items identified in Table 601, can coincide with the airframe tolerance intervals). Engines which operate in sandy or dusty areas or in smog or salt-laden atmospheres which are considered extreme in terms of environmental harshness (Ref. Fig. 602) must be inspected for corrosion and the LP and HP compressors must be regularly inspected for erosion.

   C. Table 602 lists the components which must be inspected during a hot section inspection (HSI). Intervals for HSI are listed in the latest revision to SB7003. Paragraph 9. has procedures which are to be followed for listed special conditions inspection.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC06-032A	Antiseize Compound

3. Special Tools

   The special tools listed below are used in the following procedures.

Tool No.	Name
PWC31540	Wrench, Rotating, HP Compressor
PWC34913	Holding Fixture, Borescope Inspection

4. Fixtures, Equipment and Supplier Tools

   The fixtures, equipment and supplier tools listed below are used in the following procedures.

Name	Remarks
A 5 mm or less borescope is recommended	

5. Corrosion

   High temperature alloy corrosion may be identified as metal loss or pitting, but more usually appears as local swelling or buildup due to greater volume occupied by nickel oxides. These corrosion products vary in color from black to green and in the advanced state there will be cracking and flaking, referred to as exfoliation. Care should be taken to distinguish

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between corrosion buildup and possible light brown or rust-colored deposits which are essentially harmless combustion by-products. The latter are usually more widespread over hot section components and, while possibly affecting performance, will not directly affect compressor mechanical integrity.

For engine corrosion inhibition procedures, refer to 72-00-00, SERVICING - Inhibition of Engine Corrosion.

6. Control Linkage

Inspect all engine controls for correct operation. Ensure that the linkage from cockpit controls to engine control levers are connected to permit full and free movement. Ensure that controls are adjusted to permit overtravel of power control lever to ensure full operation of engine and that the linkage can be operated without interference. Also investigate and eliminate any slack in the control system. Lubricate and adjust all controls (Ref. Airframe Maintenance Manual).

7. Periodic Inspection

Periodic Inspection Tolerances

A. Unless otherwise stated, the tolerance for periodic or scheduled inspections is ten percent (10%), or up to a maximum of 100 flight hours, or 30 days calendar time, whichever is less.

B. Subsequent interval will be adjusted to re-establish the original schedule. When an inspection is done more than 10% early, subsequent inspections will be advanced as required to not exceed the maximum tolerance. Concurrence and final approval of the inspection interval tolerance by the governing civil aviation authority is the responsibility of the owner / operator.

Refer to Table 601.

TABLE 601, Periodic Inspection

		INSPECTION INTERVAL	
COMPONENT	NATURE OF INSPECTION	DAILY/ PREFLIGHT	MINOR
ENGINE EXTERNALS			
Tubing, Wiring, Control Linkage and Cables	Security of all accessible connections, clamps and brackets.		X
	Evidence of wear, chafing, cracks and corrosion.		X
	Evidence of fuel or oil leaks.		X

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TABLE 601, Periodic Inspection (Cont'd)

COMPONENT	NATURE OF INSPECTION	INSPECTION INTERVAL	
		DAILY/ PREFLIGHT	MINOR
	Evidence of fraying, broken strands, security of cables and fittings.		X
	Lubricate rod end connectors.		X
Engine Mounts	Security and condition		X
Compressor Inlet	Check compressor inlet area for cleanliness.	X	X
	Visually inspect low pressure compressor blades and stator vanes for dirt deposits, corrosion and erosion. Refer to 71-00-00, CLEANING if required. If further inspection required, refer to Special Conditions Inspection - Foreign Object Damage.	X	X
	JT15D-5 (Pre-SB7264 and Pre-SB7369) engines only: inspect LP compressor bypass stator retaining rivets around circumference of LP compressor case. Ensure that all rivets are present and secure.	Every 300 hours	
LP Compressor Bypass Stator	With the stator installed on the engine, perform a visual inspection of the full circumference of bypass stator inner and outer rings for cracks originating at the airfoil/vane ring brazing root area (Ref. Fig. 601). Radial or circumferential cracks originating at the airfoil/vane ring brazing root area to a maximum length of one inch are acceptable.	Perform inspection at Hot Section Inspection (Ref. SB7003 for interval).	
Exhaust Duct	Cracks or distortion.		X
	JT15D-5 (Post-SB7472) engines only: cracks on inside diameter are not permitted to extend beyond stiffening band.		X
Accessories	Security of accessories.		X
Emergency Fuel Shutoff Linkage JT15D-5 (Pre-SB7306 only)	Using a borescope, inspect emergency fuel shutoff linkage to ensure security:		X

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TABLE 601, Periodic Inspection (Cont'd)

COMPONENT	NATURE OF INSPECTION	INSPECTION INTERVAL	
		DAILY/ PREFLIGHT	MINOR
	Borescope inspect emergency fuel shutoff linkage through the inspection port in exhaust duct cone. Verify shutoff linkage is intact at the No. 4 bearing housing cover assembly.		X
	Borescope -inspect emergency fuel shutoff linkage through cut-out in rear inner bypass duct adjacent to shutoff valve. Access through back end of engine. Verify shutoff linkage is intact at the overspeed control bracket assembly.		
	Incorporate SB7306 before next flight if security of linkage assembly appears compromised.		
	Apply anti-galling compound (PWC06-032A) to threads of borescope port plug and install plug in exhaust duct. Torque plug 25 to 35 lb.in. and lockwire. Do not exceed torque value stated.		
Overspeed Control Wire Rope, JT15D-5 (Pre-SB7288)	Using a borescope, inspect overspeed control wire rope clevis and ball end-to-cable joints for security:		X
	Borescope-inspect clevis-to-wire rope joint through inspection port in exhaust duct cone. Check for broken strands at joint.		
	Borescope -inspect ball end-to-wire rope joint through cut-out in rear inner bypass duct adjacent to emergency fuel shutoff valve. This area is accessible through the back end of the engine. Check for broken strands at the joint.		
	Incorporate SB7288 before next flight if any broken strands are found.		

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TABLE 601, Periodic Inspection (Cont'd)

COMPONENT	NATURE OF INSPECTION	INSPECTION INTERVAL	
		DAILY/ PREFLIGHT	MINOR
	Apply anti-galling compound (PWC06-032A) to threads of borescope port plug and install plug in exhaust duct. Torque plug 25 to 35 lb.in. and lockwire. Do not exceed torque value stated.		
SYSTEMS			
Oil System	CAUTION : DO NOT MIX DIFFERENT BRANDS OR TYPES OF OIL WHEN CHANGING OIL OR WHEN REPLENISHING OIL BETWEEN OIL CHANGES (REF. SB7001).		
Oil Change Interval	Oil quality is to be monitored on-condition and analyzed periodically as observations warrant (Ref. 72-00-00, SERVICING).		
Oil Quantity	Check oil level (Ref. 72-00-00, SERVICING).	X	X
	Check condition and security of oil filler cap (Ref. 79-30-01).	X	X
Oil Filter Element (cleanable), JT15D-5 (Pre-SB7476) Engines	Remove the oil filter and inspect for foreign matter (Ref. 79-20-01, OIL FILTER HOUSING (JT15D-5) - MAINTENANCE PRACTICES). Reject and replace unserviceable oil filter element.		X
	Remove oil filter element and inspect for foreign matter, clean and inspect (Ref. 79-20-01, OIL FILTER HOUSING - MAINTENANCE PRACTICES). Reject and replace unserviceable oil filter element.	At 800 ± 50 hours or one year whichever comes first and at HSI interval (Ref. **SB7003** for interval).	
Oil Filter Element (non-cleanable), JT15D-5 (Post-SB7476 and Post-SB7581) and JT15D-5R Engines	Remove and inspect the oil filter for foreign matter (For JT15D-5 engines: Ref. 79-20-01, OIL FILTER HOUSING - MAINTENANCE PRACTICES), (For JT15D-5R engines: Ref. 79-21-01, OIL FILTER HOUSING - MAINTENANCE PRACTICES). Reject and replace the oil filter if any foreign matter is found.	At HSI interval (Ref. **SB7003** for interval).	X

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TABLE 601, Periodic Inspection (Cont'd)

COMPONENT	NATURE OF INSPECTION	INSPECTION INTERVAL	
		DAILY/ PREFLIGHT	MINOR
	Remove and inspect the oil filter for foreign matter (For JT15D-5 engines: Ref. 79-20-01, OIL FILTER HOUSING - MAINTENANCE PRACTICES),(For JT15D-5R engines: Ref. 79-21-01, OIL FILTER HOUSING - MAINTENANCE PRACTICES). Reject and replace the oil filter if any foreign matter is found.	At 800 ± 50 hours or one year whichever comes first.	
Chip Detector: JT15D-5 (Post-SB7599) Engines	Check continuity of circuit at jack connector using a suitable test set (Ref. 79-30-05, MAINTENANCE PRACTICES). If closed circuit is indicated, remove and inspect chip detector.	Daily	
Chip Detection System: JT15D-5 (Post-SB7599) Engines	Perform functional check of system components (Ref. 79-30-05, MAINTENANCE PRACTICES).		X
Thermostatic Bypass Valve (JT15D-5R)	Remove and replace thermostatic bypass valve (Ref. 79-21-01)	At engine overhaul, not to exceed 4,000 hours	
Fuel System			
Fuel	Check for presence of water.	X	X
Fuel Pump	Check for security and fuel leaks.		X
Fuel Pump Inlet Screen (JT15D-5)	Check screen for foreign matter and distortion. Clean and reinstall, or install new screen (Ref. 73-10-02).		X
Fuel Filter (JT15D-5R)	Replace fuel filter (Ref. 73-10-13, FUEL FILTER AND IMPENDING BYPASS SWITCH (JT15D-5R) - MAINTENANCE PRACTICES).	Every 200 hours	
Fuel Pump Outlet Filter (10 Micron) (JT15D-5 and JT15D-5R)	Check for foreign matter and/or distortion. Install new filter at each inspection (Ref. 73-10-02).	Every 200 hours	
Fuel Pump Pop-up Indicator (JT15D-5R)	Inspect position of button. If extended, refer to 72-00-00, FAULT ISOLATION.	Every 200 hours	
Drain Valves	Security and leakage (Ref. 73-10-06).		X

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TABLE 601, Periodic Inspection (Cont'd)

COMPONENT	NATURE OF INSPECTION	INSPECTION INTERVAL	
		DAILY/ PREFLIGHT	MINOR
Hydromechanical Unit	Ensure HMU has been inspected in accordance with SBA-7295	Ref. SBA-7295	
	Security and leakage (Ref. 73-20-02).		X
	Free movement of linkage.		X
	Pre-SB7611: Drain condensation trap.	Every 400 hours	
Flow Divider and Dump Valve	Security and leakage (Ref. 73-10-04, FLOW DIVIDER VALVE - MAINTENANCE PRACTICES). NOTE: Leakage must not be more than 3 cc/minute.		X
Ignition System			
Ignition Exciter	Security and condition (Ref. 74-10-01).		X
Ignition Cables	Chafing, wear and security (Ref. 74-20-01).		X
Spark Igniters	Cleanliness and erosion (Ref. 74-20-02).	Every 200 hours	
	Operational test (Ref. 74-00-00).	Every 200 hours	
	Pre-SB7210 engines only: Install new spark igniters (Ref. 74-20-02).	Every 50 hours	
Engine			
Flange 'C' Bolts (Ref. 72-40-01 and 72-70-01)	Replace flange'C' bolts on engines not incorporating Service Bulletin SB7245 (Ref. Service Bulletin SB7250)	Every 400 hours	
Extreme Environment Inspection	For engine operating more than 40% of the time in zones considered extreme in term of environmental harshness per environmental maps (Ref. Fig. 602).		X
	Inspect the intermediate case for corrosion. Treat for corrosion as required (Ref. 71-00-00, POWER PLANT - CLEANING).		X

8. Hot Section Inspection

A. Procedure

(1) Accomplish engine turbine hot section inspection as follows:

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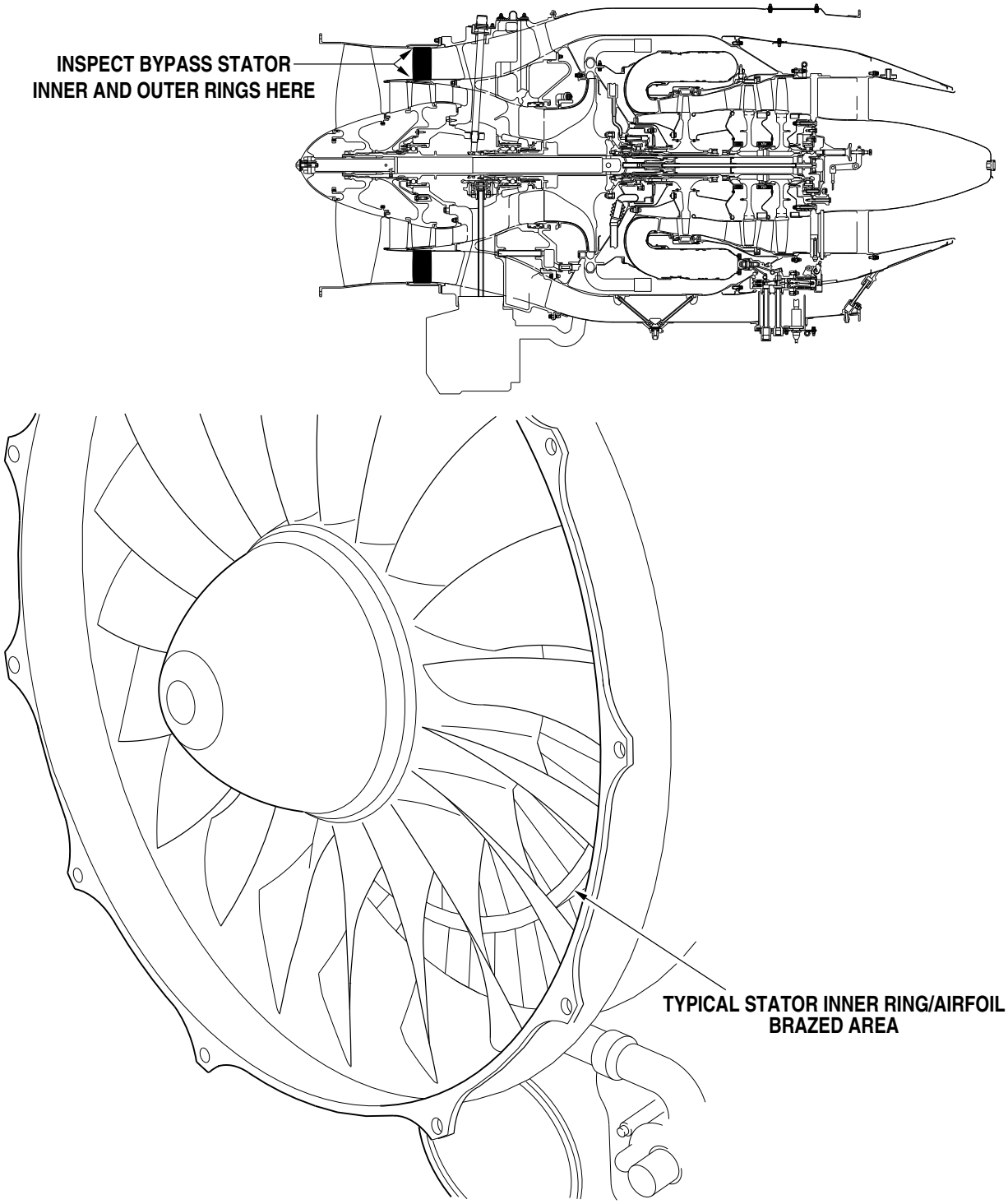

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In-Situ Inspection of LP Compressor Bypass Stator
Figure 601

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C160362

Extreme Environment Map
Figure 602 (Sheet 1 of 7)

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Extreme Environment Map
Figure 602 (Sheet 2)

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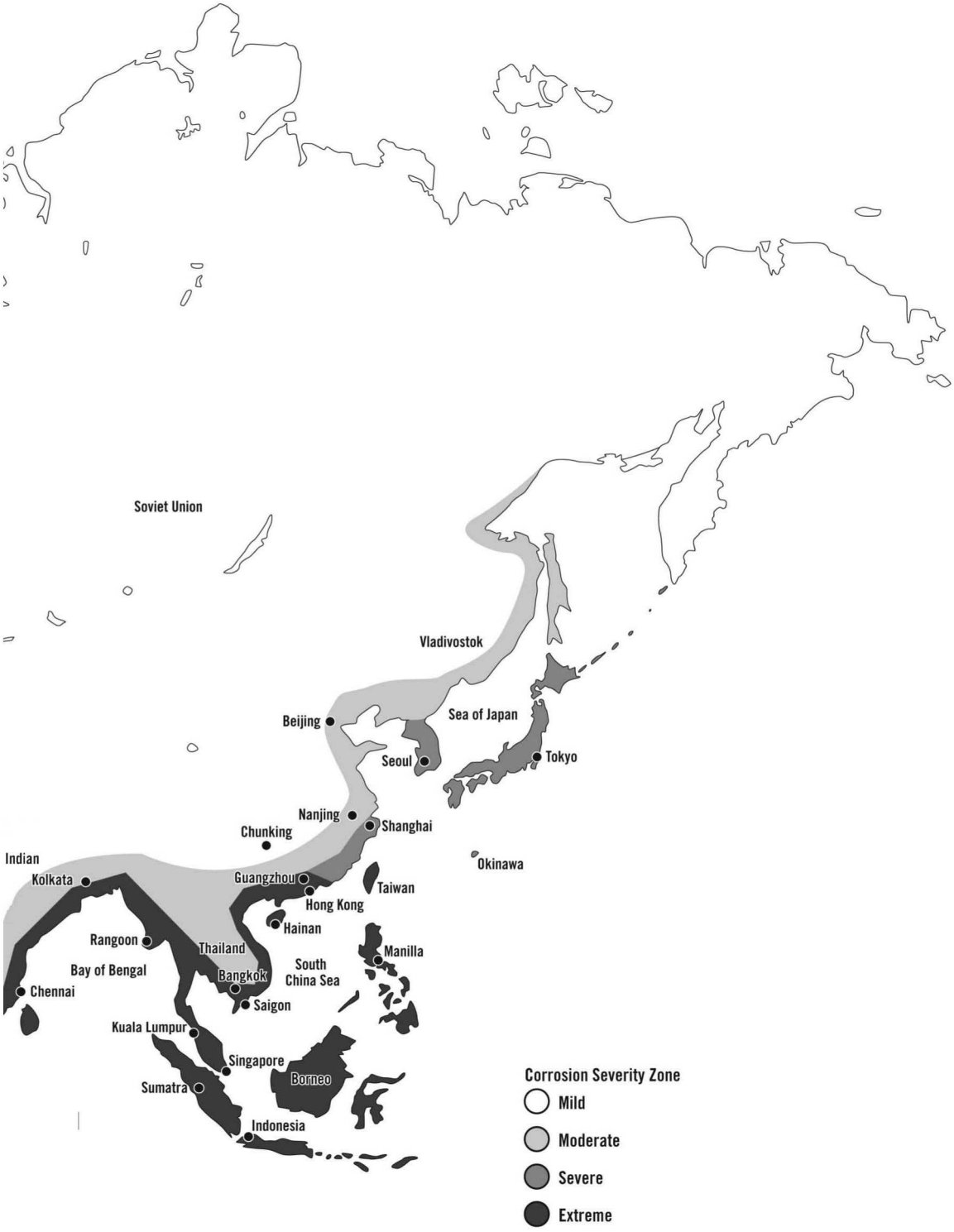

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Extreme Environment Map
Figure 602 (Sheet 3)

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Extreme Environment Map
Figure 602 (Sheet 4)

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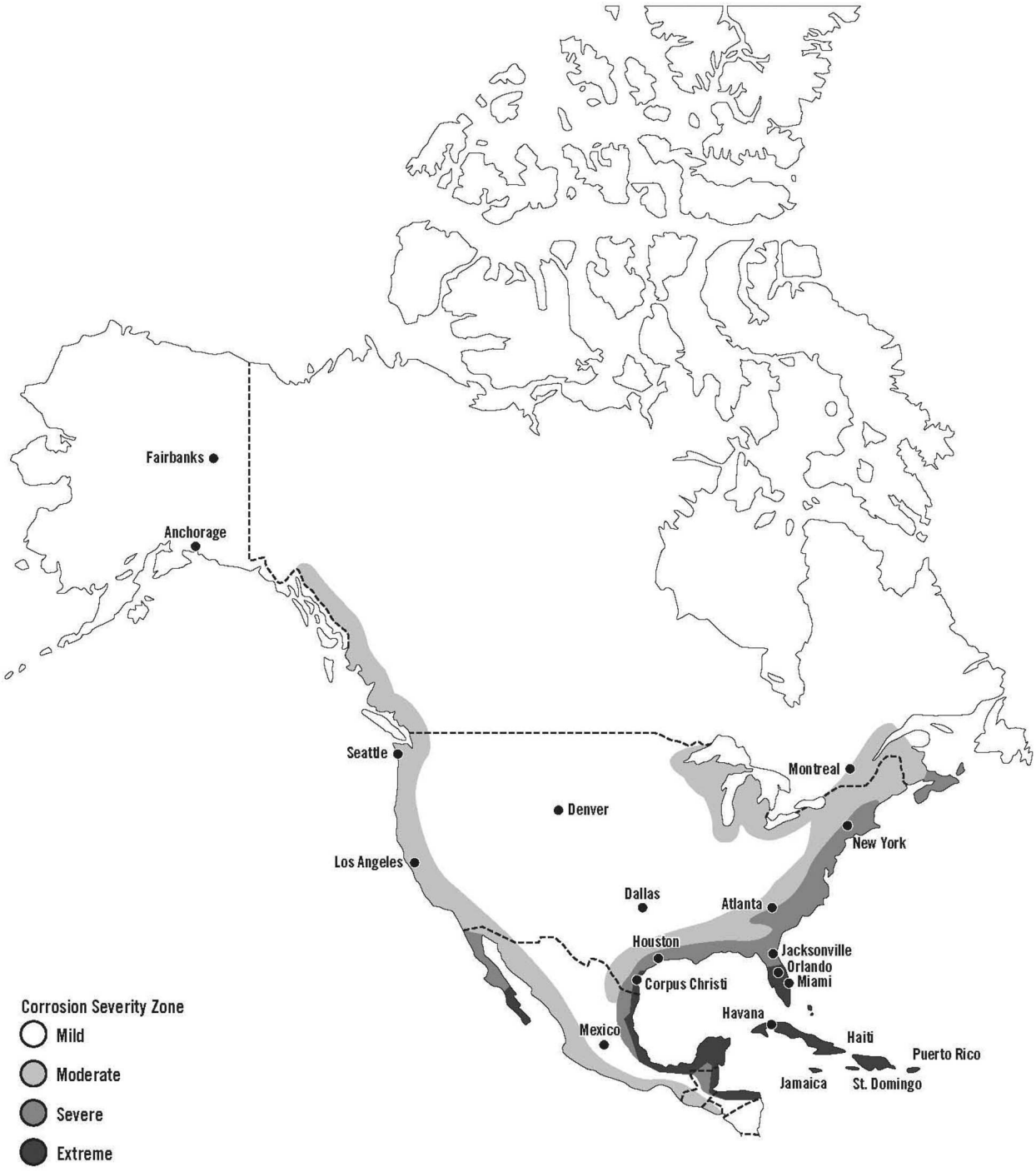

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Extreme Environment Map
Figure 602 (Sheet 5)

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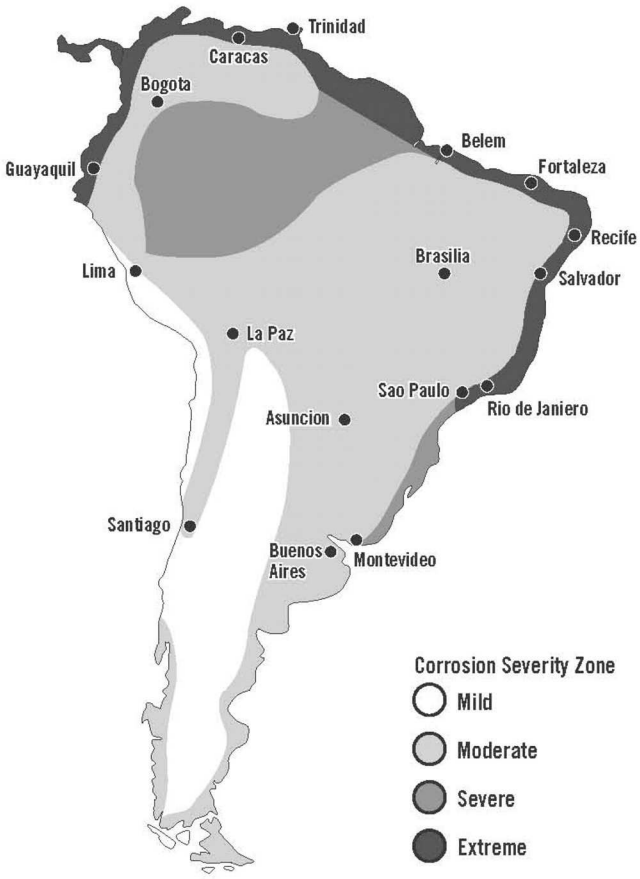

C160366

Extreme Environment Map
Figure 602 (Sheet 6)

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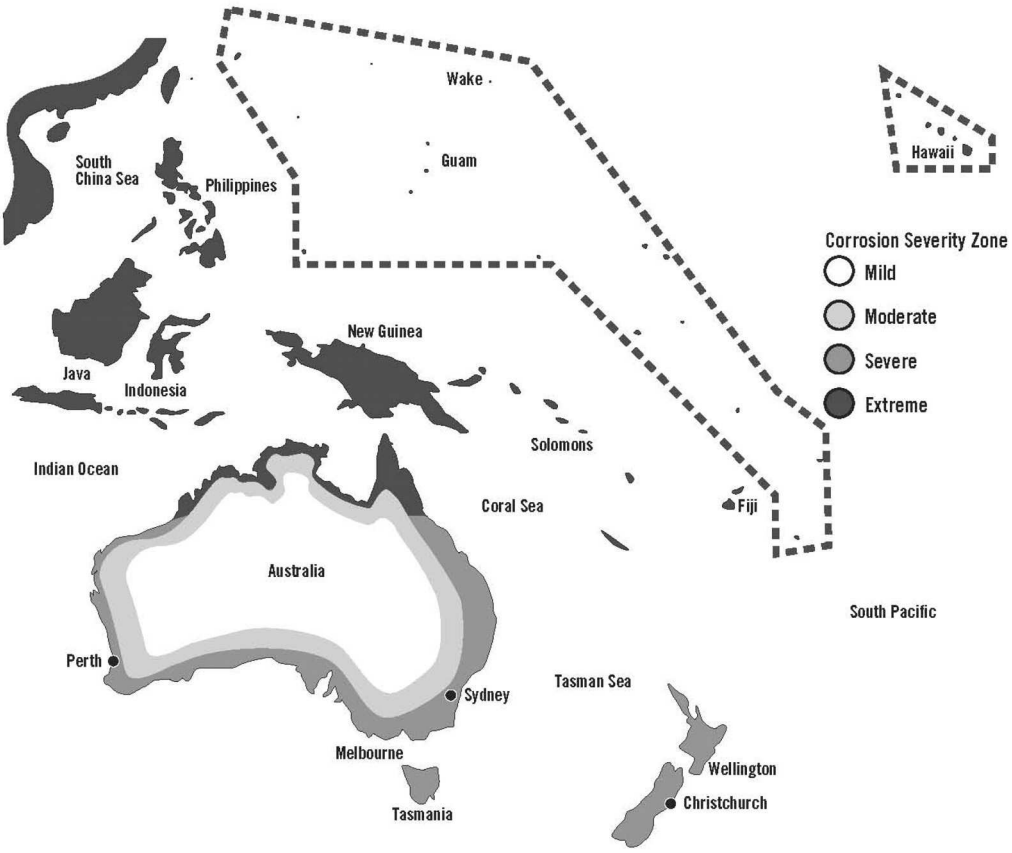

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Extreme Environment Map
Figure 602 (Sheet 7)

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(a) Inspect impeller (Ref. 72-30-06) and LP compressor boost rotor (Ref. 72-30-03) before HSI. If limits are exceeded, send engine to an approved overhaul facility for inspection and repair.

(b) Remove turbine exhaust duct and No. 4 bearing housing assembly (Ref. 72-50-06).

(c) Remove low pressure turbine rotor balancing assembly (Ref. 72-50-03) and low pressure turbine stator assembly (Ref. 72-50-04).

(d) Remove low pressure turbine stator support assembly with combustion chamber liner (Ref. 72-40-01).

(e) Remove combustion chamber liner from LP turbine stator support (Ref. 72-40-01).

(f) Remove high pressure turbine disk assembly (Ref. 72-50-02).

(g) Remove high pressure turbine stator and small exit duct assembly (Ref. 72-50-01).

NOTE: Further disassembly should be effected only to an extent necessary to replace damaged/defective parts or if a performance problem exists in operation where hot section components are suspected. Should it be necessary to perform a more detailed inspection of components which have not been disassembled, (i.e. high turbine stator, small exit duct and sealing ring, large exit duct), these parts should be removed (refer to relevant chapters in Table 602). It is necessary to remove small and large exit ducts in order to inspect gas generator diffuser pipes.

(h) Perform hot section component inspection procedures (Ref. Table 602).

(i) Install acceptable or replaced hot section components after HSI is completed. Assembly sequence is reverse of sequence detailed by steps (a) through (g). Refer to installation procedures in referenced chapters.

(j) Perform required ground checks (Ref. 71-00-00, ADJUSTMENT/TEST).

TABLE 602, Hot Section Inspection

COMPONENT	NATURE OF INSPECTION
Exhaust Duct and No. 4 Bearing Housing Assembly	Cracks, distortion of duct, condition of bearing housing assembly and attaching bolts for security; separate No. 4 bearing housing and cover assemblies; clean and inspect bearing housing cover and emergency fuel shut-off actuating rod (Ref. 72-50-06).
Rear Inner Bypass Duct	Cracks (Ref. 72-70-02).

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TABLE 602, Hot Section Inspection (Cont'd)

COMPONENT	NATURE OF INSPECTION
Low Pressure Turbine Rotor Balancing Assembly	Blade shift (second and third-stage rotor assemblies), blade damage, interstage baffle and stator assembly for condition (Ref. 72-50-03). Labyrinth seal wear.
Flange C Bolts	Prior to installation, inspect bolts for cracks, corrosion and damaged heads. Inspect bolt threading. Replace unacceptable bolts (Ref. 72-40-01 and 72-70-01). Disposition of bolts at HSI as follows: For JT15D-5 (Pre-SB7324) engines with P/N 3111850-01 bolts and JT15D-5 (Post-SB7324) and JT15D-5R engines only, retain bolts for reuse after HSI. For all other engines, discard bolts at HSI.
Low Pressure Turbine Stator Support Assembly	Wear, fretting (Ref. 72-40-01).
Low Pressure Turbine Stator Assembly	Cracks, erosion, impact damage (Ref. 72-50-04).
Interstage Seal Ring	Fretting wear, distortion (Ref. 72-50-01).
Combustion Chamber Liner	Cracks, distortion, fretting, hot spots, carbon buildup. Clean as required (Ref. 72-40-01).
Fuel Nozzles	Carbon buildup. Functional check and clean as required (Ref. 73-10-05). NOTE: To further improve hot end durability, Pratt & Whitney Canada recommends a complete set of 12 fuel nozzles is replaced with an exchange set at HSI.
High Pressure Turbine Assembly	Blade shift, tip clearance, erosion, loss of coating, impact damage, cracks (Ref. 72-50-02).
No. 3 Bearing Rear Rotor Air Seal	Condition, rub (Ref. 72-50-02).

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TABLE 602, Hot Section Inspection (Cont'd)

COMPONENT	NATURE OF INSPECTION
High Pressure Turbine Shroud Segments	Cracks, visible without disassembly, distortion, erosion, metal buildup, blade tip clearance (Ref. 72-50-01).
High Pressure Turbine Air Seal and Baffle	Cracks, distortion (Ref. 72-50-01).
No. 3 Bearing Stator Air Seal	Condition, rub (Ref. 72-50-01).
High Pressure Turbine Stator Assembly	Cracks, coating loss, erosion, impact damage (Ref. 72-50-01).
High Pressure Turbine Stator Seal Ring: JT15D-5 (Post-SB7273) and JT15D-5R (if removed)	Fretting wear, distortion (Ref. 72-50-01).
Large Exit Duct	Cracks, burning, distortion (Ref. 72-50-01).
Small Exit Duct	Cracks, burning, distortion, loose rivets (Ref. 72-50-01).
Gas Generator Case	Cracks, distortion, overheating (Ref. 72-30-05).
Gas Generator Case - Diffuser Pipes	Cracks (Ref. 72-30-05).
JT15D-5 (Pre-SB7476)Oil Filter Element	Remove, inspect and field clean JT15D-5 (Pre-SB7476) oil filter element (Ref. 79-20-01, MAINTENANCE PRACTICES). Install existing or serviceable oil filter element.
JT15D-5 (Post-SB7476 and Post-SB7581) and JT15D-5ROil Filter Element	Remove, inspect and discard existing JT15D-5 (Post-SB7476 or Post-SB7581) and JT15D-5R oil filter element (Ref. 79-20-01/79-21-01, MAINTENANCE PRACTICES). Install new oil filter element.
Emergency Fuel Shut-off Control Linkage	Wear, fretting (Ref. 72-50-06)
T1 Temperature Probe Wiring Harness	Inspect for damage, broken wires and general condition of insulation (Ref. 77-00-01, Inspection/Check). Perform all harness electrical checks (Ref. Adjustment/Test).

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TABLE 602, Hot Section Inspection (Cont'd)

COMPONENT	NATURE OF INSPECTION
T6 Thermocouple Wiring Harness	Inspect for damage, broken wires and general condition of insulation (Ref. 77-00-02, Inspection/Check). Perform all harness electrical checks (Ref. Adjustment/Test).
T6 Thermocouple Probes	Perform insulation resistance, resistance between terminal and heat response checks (Ref. 77-00-02, Adjustment/Test).

9. Special Conditions Inspection

When unusual engine conditions such as engine overspeed, foreign object damage, lightning strike or loss of oil are experienced, perform appropriate special conditions inspection.

A. Engine Overtemperature

For engine overtemperature limits, inspection requirements and engine disposition, refer to Chapter 71-00-00, ADJUSTMENT/TEST, Test Information.

B. Foreign Object Damage (FOD)

(1) General

(a) Investigate each instance of FOD with respect to cause and circumstance.

(b) Consider the integrity of complete engine when evaluating damage to LP compressor stage or inlet cone. This is especially true in instances where damage incurred exceeds heavy maintenance limits (Ref. 72-30-03, Inspection/Check).

(c) Inspect leading edges of impeller vanes for damage (Ref. Subpara. B.(3), Intermediate Case Borescope Inspection). Inspect leading edges of LP compressor boost stage rotor blades for damage (Ref. 72-30-03).

(d) If impeller or boost stage damage limits are exceeded, or if it is suspected that a foreign object has passed through the primary gas path beyond the impeller, send engine to an approved overhaul facility for inspection and repair.

(e) Inspect the LP compressor stator for presence and security of retaining rivets (Ref. 72-30-01, LP COMPRESSOR CASE AND STATORS - MAINTENANCE PRACTICES).

(f) If the components are serviceable, rotate the LP and HP rotors with your hand and listen for unusual noises. If unusual noises are heard, return the engine to an approved overhaul facility for inspection and repair.

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(g) Inspect the chip detector (Ref. 79-30-05, CHIP DETECTION SYSTEM - MAINTENANCE PRACTICES) and the oil filter element ((Ref. 79-20-01, OIL FILTER HOUSING (JT15D-5) - MAINTENANCE PRACTICES), (Ref. 79-21-01, OIL FILTER HOUSING (JT15D-5R) - MAINTENANCE PRACTICES)). If debris is found in the oil filter or chip detector, refer to the fault isolation chart for discolored oil.

(h) Start the engine (Ref. 71-00-00, POWER PLANT - ADJUSTMENT/TEST), do a ground run (Ref. AMM) and a vibration survey (Ref. 71-00-00, POWER PLANT - ADJUSTMENT/TEST). Check that the engine operates normally.

(2) Soft Object Impact Damage

(a) Inspect LP compressor (fan) blades. A typical indication of soft object impact damage is an outward bend at or near the leading edge tip of blade. Refer to 72-30-03, Inspection/Check for fan blade inspection criteria.

(b) In addition to inspection as per Para. B. (1) Steps (a) thru (g), inspect LP compressor stator assemblies and retaining rivets if engine is to remain in service (Ref. 72-30-01, LP COMPRESSOR CASE AND STATORS - MAINTENANCE PRACTICES).

(c) Start the engine (Ref. 71-00-00, POWER PLANT - ADJUSTMENT/TEST) and do a ground run (Ref. AMM). Check that the engine operates normally.

(3) Intermediate Case Borescope Inspection

(a) Inspect the primary gas path using a borescope of approx. 0.200 inches dia. and min. length of 12 inches. Insert through inspection port in intermediate case immediately rear of N1 rotor speed sensor housing.

1 Remove two plain washers and nuts securing access cover.

2 Insert borescope and inspect impeller vane leading edges by viewing between impeller guide vanes (Ref. 72-30-06, Inspection/Check for limits).

3 Rotate high pressure rotor assembly to permit inspection of all impeller vanes.

4 When borescope inspection is completed, replace access cover and secure with two washers and self-locking nuts. Torque nuts 36 to 40 lb.in.

(4) Aircraft or Engines Subjected to Bird Strike

(a) Inspect LP compressor (fan) blades (Ref. 72-30-03, LP COMPRESSOR ROTOR ASSEMBLIES- MAINTENANCE PRACTICES).

(b) In addition to inspection as per Para. B. (1) Steps (a) thru (h), inspect LP compressor stator assemblies and retaining rivets (Ref. 72-30-01, LP COMPRESSOR CASE AND STATORS - MAINTENANCE PRACTICES).

(c) Do a borescope inspection of the external surface of the combustor assembly for debris. Access can be made through P3 aircraft bleed port.

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(d) Do a fan wash and a compressor wash (Ref. 71-00-00, POWER PLANT - CLEANING). Check that the bleed ports are clear of contamination.

(e) Start the engine (Ref. 71-00-00, POWER PLANT - ADJUSTMENT/TEST) and do a ground run (Ref. AMM). Check that the engine operates normally.

C. Loss of Oil

(1) If remaining oil is less than 2.5 US quarts (2.36 liters) and:

- oil pressure fluctuated and/or fell below normal value but not less than 35 psig, or
- engine was shutdown after oil pressure fell below 35 psig and engine windmilled for remainder of flight.

(a) Determine cause of oil loss and rectify (Ref. 72-00-00, SERVICING).

(b) Inspect AGB sleeve strainer (Ref. 72-60-02). Inspect engine oil filter element (Ref. 79-20-01) and proceed as follows:

1 If metal particles are found in AGB sleeve strainer, remove engine from service and return to an approved overhaul facility for inspection in accordance with Special Conditions Inspection procedure for loss of oil in overhaul manual.

2 If metal particles are found in oil filter element, refer to Chapter 79-20-01/79-21-01, Inspection/Check.

3 If no metal particles are found, service oil system (Ref. 72-00-00, SERVICING) and continue to step (c).

(c) Perform dry motoring run (Ref. 71-00-00, ADJUSTMENT/TEST). Listen for unusual engine noise indicating possible bearing damage:

1 If unusual engine noise is detected, remove engine from service and return to an approved overhaul facility for inspection in accordance with Special Conditions Inspection procedure for loss of oil in overhaul manual.

2 If no unusual engine noise is detected, perform 15 minute engine run (Ref. 71-00-00, ADJUSTMENT/TEST).

(d) Inspect gearbox sleeve strainer (Ref. 72-60-02) and engine oil filter (79-20-01/79-21-01). If satisfactory, and oil pressures were acceptable during engine run, continue engine in service. If metal particles are present in gearbox screen, return engine to an approved overhaul facility. If metal particles are present in oil filter element only, refer to Chapter 79-20-01/79-21-01, Inspection/Check.

(2) If remaining oil is less than 2.5 US quarts (2.36 liters) and engine oil pressure fell below 35 psig. and engine was not shut down:

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(a) Remove engine and return to an approved overhaul facility for inspection in accordance with Special Conditions Inspection procedure for loss of oil in overhaul manual.

D. Engine Overspeed

For engine overspeed limits and procedures, refer to Chapter 71-00-00, ADJUSTMENT/TEST, Test Information.

E. Engine Windmilling

(1) Engine windmilling on ground :

(a) No action required.

(2) If engine windmilling in flight does not exceed 15 minutes :

(a) No action required.

(3) If engine windmilling in flight exceeds 15 minutes:

NOTE: If windmilling exceeds 15 minutes with fuel shut off or no fuel boost pressure also refer to step (6).

(4) WITH positive oil pressure indication :

(a) No action required.

(5) WITHOUT positive oil pressure indication :

(a) Check oil filter (Ref. 79-20-01/79-21-01).

(b) Perform engine ground run checks 1 through 4 (Ref. 71-00-00, ADJUSTMENT/TEST). Check oil filter after ground run (Ref. 79-20-01/79-21-01).

(6) WITH fuel shut off or no fuel boost pressure:

(a) Remove fuel pump outlet filter element and check for contamination (Ref. 73-10-02). Install new filter element.

(b) Check fuel pump (Ref. 71-00-00).

(c) Check fuel filter element following fuel pump check. If contaminated, replace fuel pump (Ref. 73-10-02).

F. Engine Immersion in Water

(1) Send engine to an approved overhaul facility for inspection.

G. Engine Dropped During Handling

(1) Send engine to an approved overhaul facility for inspection.

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H. Lightning Strike

(1) Aircraft or engine subjected to lightning strike: visually inspect engine inlet. If evidence of arcing (pitting, black scarring) is present on inlet cone or LP compressor blades, remove engine from service. Return engine to an approved overhaul facility for lightning strike Special Conditions inspection (Ref. Overhaul Manual).

I. Engine Exposed to Fire Extinguishing Agent

(1) If engine has **ingested** fire extinguishing foam, fire extinguishing powder or other chemical fire extinguishers from aircraft or other fire extinguishing systems, remove engine and send to an approved overhaul facility for procedures in accordance with Overhaul Manual, 72-00-00, LIGHT OVERHAUL, Special Conditions Inspections - Fire Extinguishing Agent Ingested by Engine.

(2) If engine has been exposed to fire extinguishing foam, fire extinguishing powder or other chemical fire extinguishers from aircraft or other fire extinguishing systems **externally only**, refer to 71-00-00, CLEANING and perform Engine External Wash. Following external wash, inspect engine for corrosion at periodic inspection intervals (Ref. 72-00-00, Inspection).

(3) If the engine has been exposed to Halon from aircraft or other fire extinguishing systems, internally or externally, no maintenance action is required.

(4) If engine has been involved in an incident involving fire extinguishing agents, but has not ingested or been exposed externally to fire extinguishing foam, fire extinguishing powder or other chemical fire extinguishers from aircraft or other fire extinguishing systems, no maintenance action is required.

J. Heavy/Hard Landing

NOTE: Refer to the Aircraft Maintenance Manual for additional inspection requirements

(1) Check aircraft/engine connections for security.

(2) Inspect the engine mounts for cracks or distortion.

(3) Inspect the engine inlet and fan case and the engine exhaust duct for distortion or damage.

(4) Check all engine mounted accessories for security.

(5) Remove and inspect the engine main oil filter (Ref. 79-20-01).

(6) Use wrench (PWC31540) in the starter-generator pad to manually turn the HP rotor. Listen for unusual noise coming from AGB or engine that could indicate damage to rotating components.

(7) Turn LP rotor assembly by hand. Listen for unusual noise coming from rotating components that could indicate damage to engine rotating components.

(8) Run engine for 10 minutes at idle. Repeat oil filter verification per step (5).

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(9) Perform an engine ground check (Ref. 71-00-00, POWER PLANT - ADJUSTMENT/TEST).

(10) Repeat oil filter verification per step (5) after 10 flight-hours.

(11) If any defects are found, remove engine and send to an overhaul facility.

K. Aircraft Flown Through a Cloud of Volcanic Ash

(1) Do a compressor and turbine wash (Ref. 71-00-00, CLEANING).

(2) Drain and refill oil system with new oil (Ref. 72-00-00, SERVICING).

(3) Replace oil filter (Ref. 72-00-00, SERVICING).

(4) Do a borescope inspection of the compressor (Ref. 72-00-00, INSPECTION).

(5) Do a borescope inspection of the HP turbines (Ref. 72-00-00, INSPECTION) and check for glass-like deposits on turbine blades. If found, do a hot section inspection.

(6) Return engine to service if no unsatisfactory conditions are found.

(7) Drain and refill oil system with new oil (Ref. 72-00-00, SERVICING), 50 ± 10 flight hours after original oil change done at Step 2.

L. Starter Generator Fail Indication

(1) If the starter generator fail light came ‘‘ON’’ during flight and the starter generator was found to be damaged, excessive vibrations possibly have caused damage to accessories mounted on the engine and fuel / oil tubes in the surrounding areas. Do the following checks:

(a) Remove the starter and then inspect the AGB starter generator pad for any damage. Replace AGB, if damage is found (Ref. 72-60-01, ACCESSORY GEARBOX AND DRIVESHAFT - MAINTENANCE PRACTICES).

(b) Inspect the AGB starter generator shaft splines. Replace AGB, if damage is found (Ref. 72-60-01, ACCESSORY GEARBOX AND DRIVESHAFT - MAINTENANCE PRACTICES).

(c) Inspect starter generator splines. Replace starter generator, if damage is found (Ref. AMM).

(d) Rotate the AGB manually and check for unusual noise. Replace AGB, if unusual noise is heard (Ref. 72-60-01, ACCESSORY GEARBOX AND DRIVESHAFT - MAINTENANCE PRACTICES).

(e) Replace the starter generator AGB seal (Ref. 72-60-02, AGB EXTERNALS AND OIL PUMP- MAINTENANCE PRACTICES).

(f) Replace the centrifugal breather gearshaft carbon face seal (Ref. 72-60-02, AGB EXTERNALS AND OIL PUMP- MAINTENANCE PRACTICES).

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(g) Do a visual inspection of all accessories, fuel tubes, P3 tubes and oil tubes for leakage, damage, cracks and security.

(h) Remove and inspect the engine oil filter for debris ((Ref. 79-20-01, OIL FILTER HOUSING (JT15D-5) - MAINTENANCE PRACTICES), (Ref. 79-21-01, OIL FILTER HOUSING (JT15D-5R) - MAINTENANCE PRACTICES)).

(i) If debris was found on chip detector, determine size and composition of foreign material before further engine operation ((Ref. 79-20-01, OIL FILTER HOUSING (JT15D-5) - MAINTENANCE PRACTICES), (Ref. 79-21-01, OIL FILTER HOUSING (JT15D-5R) - MAINTENANCE PRACTICES)).

(j) If debris was found in the oil filter or on the chip detector, drain, flush and fill the engine oil system (Ref. 72-00-00, ENGINE: TURBINE - SERVICING).

(k) Start the engine and stabilize at ground idle power (Ref. AMM).

(l) Operate the engine at takeoff power for five minutes followed by three cycles of 20 minutes consisting of 10 minutes at idle and 10 minutes at cruise power.

(m) During engine runs, check for unusual vibration.

(n) Check for external fuel / oil leaks.

(o) Shut the engine down.

(p) Again check oil filter ((Ref. 79-20-01, OIL FILTER HOUSING (JT15D-5) - MAINTENANCE PRACTICES), (Ref. 79-21-01, OIL FILTER HOUSING (JT15D-5R) - MAINTENANCE PRACTICES)) and chip detector (Ref. 79-30-05, CHIP DETECTION SYSTEM - MAINTENANCE PRACTICES).

(q) If debris is present, follow the recommendations ((Ref. 79-20-01, OIL FILTER HOUSING (JT15D-5) - MAINTENANCE PRACTICES), (Ref. 79-21-01, OIL FILTER HOUSING (JT15D-5R) - MAINTENANCE PRACTICES)).

10. Borescope Inspection

NOTE: Borescope inspection is not intended to replace or diminish the importance of doing an HSI, but is intended as a way to monitor the internal components of the engine to help reduce the cost of future repairs/refurbishments.

A. General

The borescope is an optical device which lets an operator examine internal areas of the engine without removal or disassembly of the engine. Access is through ports or openings created by removal of engine components. Personnel doing inspection should be qualified to use borescope and analyze results. Use care and attention when handling/using equipment.

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B. Description

DELETED.

DELETED.

The borescope is fragile and vulnerable to radiation, shock, excessive twisting and pinching. Extreme care is required during handling to avoid damage and to prolong service life.

C. Basic Use of Borescope

CAUTION: HEAT CAN DAMAGE THE BORESCOPE. ENGINE TEMPERATURE MUST BE LESS THAN 66°C (150°F) BEFORE YOU DO AN INSPECTION. THE SATISFACTORY COOLING PERIOD FOR STANDARD AMBIENT CONDITIONS IS 40 MINUTES (COLD SECTION) OR TWO HOURS (HOT SECTION) AFTER ENGINE SHUTDOWN, BUT CAN CHANGE WITH AMBIENT CONDITIONS. IF REQUIRED, DO DRY MOTORING RUNS TO ACCELERATE COOLING (REF. 71-00-00, POWER PLANT - ADJUSTMENT/TEST).

(1) DELETED.

(2) Using the borescope an operator can perform periodic inspection of the following:

- LP compressor boost stage rotor blade leading edges.
- LP compressor stator vanes and rivets.
- HP turbine blade trailing edges.
- No.4 bearing housing, No. 4 bearing cover and cover overspeed control linkage.
- Engine fuel nozzles
- Cooling rings and dome section of combustion chamber liner.
- Small and large exit ducts.
- Impeller and stator vanes.

(3) DELETED.

D. Removal /Installation of Side Viewing Adapter (Ref. Fig. 603)

(1) DELETED.

E. Removal/Installation of Camera

(1) DELETED.

F. LP Compressor Boost Stage Rotor and Front Inner Stator (Ref. Fig. 604)

(1) Engage borescope between fan blades and between LPC front inner compressor stator vanes.

(2) Inspect boost stage (Ref. 72-30-03, Inspection/Check).

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Side-viewing Adapter
Figure 603

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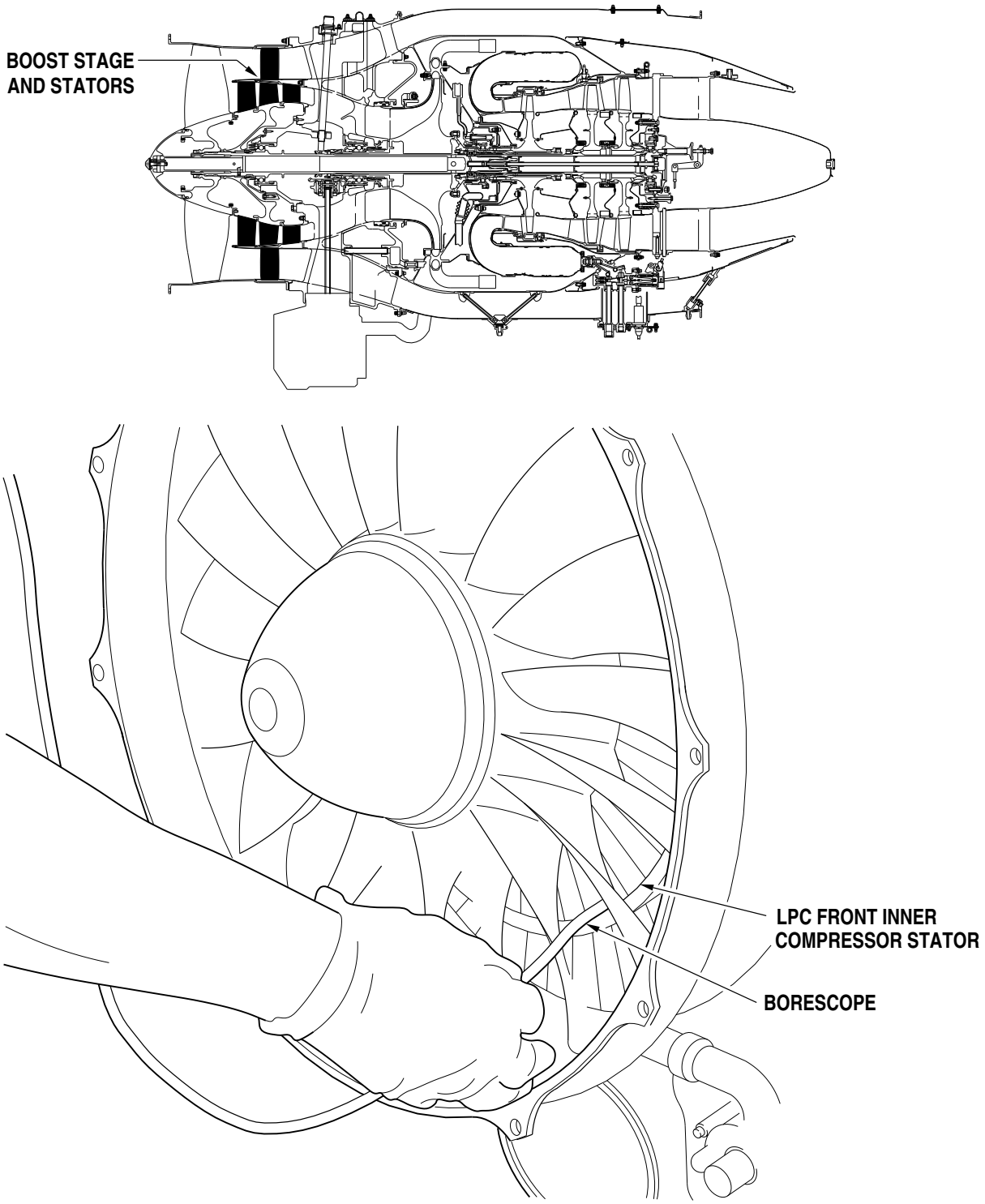

Borescope Inspection of LPC Boost Stage Rotor (Typical)
Figure 604

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Key to Figure 604

1. DELETED
2. DELETED

(3) Inspect front stator vane (Ref. 72-30-01, Inspection/Check).

G. Impeller (Ref. Fig. 605)

(1) Remove two nuts (2) and washers (3) securing borescope inspection port cover (4) to pad on intermediate case.

(2) Remove cover (4).

(3) Insert borescope (1).

(4) Rotate HP compressor rotor manually using wrench (PWC31540) installed in splined starter-generator drive pad (Ref. 72-60-02, AGB EXTERNALS AND OIL PUMP- MAINTENANCE PRACTICES), to permit inspection of all impeller and vanes (Ref. 72-30-06, HIGH PRESSURE COMPRESSOR ASSEMBLY - MAINTENANCE PRACTICES).

(5) When borescope inspection is complete, install access cover (4) and secure with two washers (3) and self-locking nuts (2). Torque nuts 36 to 40 lb.in.

H. Fuel Nozzles, Combustion Chamber and Large Exit Duct (Ref. Fig. 606)

WARNING: VOLTAGE USED IN IGNITION SYSTEM IS DANGEROUSLY HIGH. BEFORE DISASSEMBLING ANY PART OF SYSTEM, SWITCH IGNITION OFF, DISCONNECT INPUT TO EXCITER AND ALLOW AT LEAST SIX MINUTES TO ELAPSE BEFORE FURTHER WORK. ALWAYS USE INSULATED TOOLS TO REMOVE COUPLING NUTS . DO NOT TOUCH OUTPUT CONNECTORS OR COUPLING NUTS WITH BARE HANDS.

(1) Remove a single spark igniter cable and spark igniter from port (1) on outboard side of engine in accordance with Chapter 74-20-02.

(2) Insert borescope (2) into vacant spark igniter port (1). Manipulate the borescope towards rear of engine to view fuel nozzle assemblies and combustion chamber liner inner dome. Manipulate the borescope towards the front of the engine to inspect the large exit duct (LED).

NOTE: Visual inspection of areas of the engine hot section that are accessible to a borescope can identify early deterioration of the components. However, when borescope inspection criteria are found to be acceptable and engine performance is found to be limited, this may be caused by an engine hot section component that cannot reached by borescope. When engine troubleshooting has confirmed that cases of performance loss are hot section-related, it is recommended that an HSI/repair be scheduled to correct the cause and recover engine performance.

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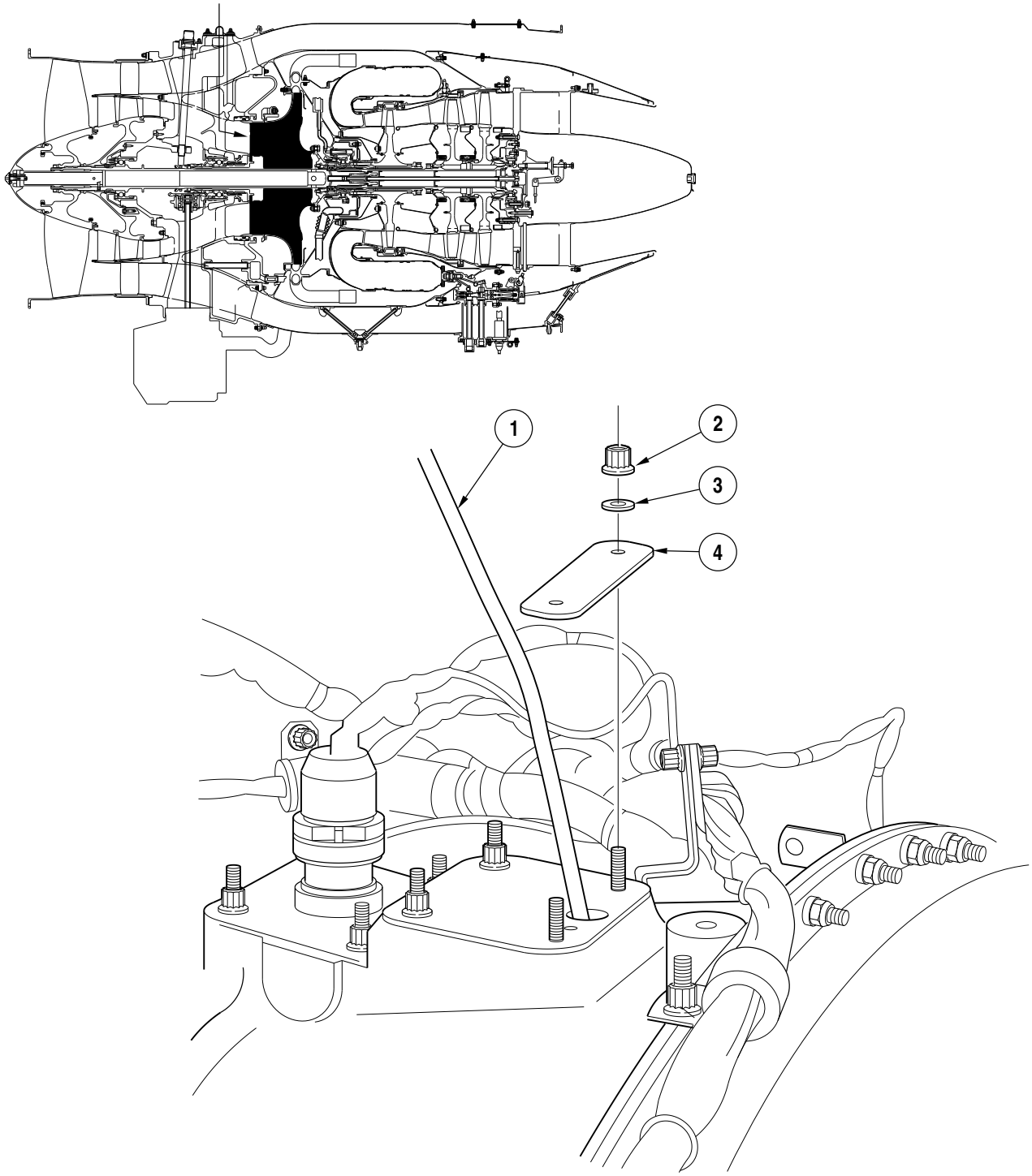
IMPELLER INSPECTION



C64581

Borescope Inspection of HP Compressor (Typical)
Figure 605

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Key to Figure 605

1. Borescope Fiberscope
2. Self-locking Nut
3. Washer
4. Borescope Inspection Port Cover

(3) Fuel nozzle inspection limits: reject and replace nozzle(s) with burned material and distortion (Ref. 73-10-05). Carbon formation is acceptable. Fuel nozzle replacement may be recommended to avoid distress to hot section components.

(4) Combustion chamber inspection limits:

(a) Cooling rings: any number of cracks are acceptable, if the cracks do not converge. Local heavy oxidation, erosion and material loss that may be associated with cracking is acceptable.

(b) Inner and outer wrapper, including the outer nose/dome: cracks and open cracks up to 0.030 inch wide that may propagate between several cooling holes are acceptable, providing the cracks do not form a closed pattern that could cause material to liberate. Local overheating and buckling is acceptable. Multi-pronged cracks up to 0.030 inch wide, which may be associated with local overheating are acceptable. Holes up to 0.100 inch in diameter that are associated with multi-pronged cracks are acceptable.

(c) If the combustion chamber must be rejected and replaced, refer to Chapter 72-40-01.

(5) LED inspection limits: local overheating, buckling and erosion is acceptable. Single cracks and multi-pronged cracks up to 0.010 inch wide are acceptable if the cracks do not converge. If the LED must be rejected and replaced, refer to Chapter 72-50-01.

(6) Small Exit Duct (SED) inspection limits: Inspect small exit duct for cracks. Cracks evident around inner heatshield are acceptable up to 1.25 inch long, subject to maximum of five cracks separated by at least three inches of sound material between each crack.

(7) Remove borescope equipment, then install spark igniter and spark igniter cable from outboard side of engine in accordance with Chapter 74-20-02.

I. No. 4 Bearing Housing/Overspeed Control Linkage (Ref. Fig. 607)

(1) Access engine exhaust duct rear cone (Ref. Airframe Maintenance Manual).

(2) Remove borescope inspection port plug (2) from exhaust duct rear cone (1).

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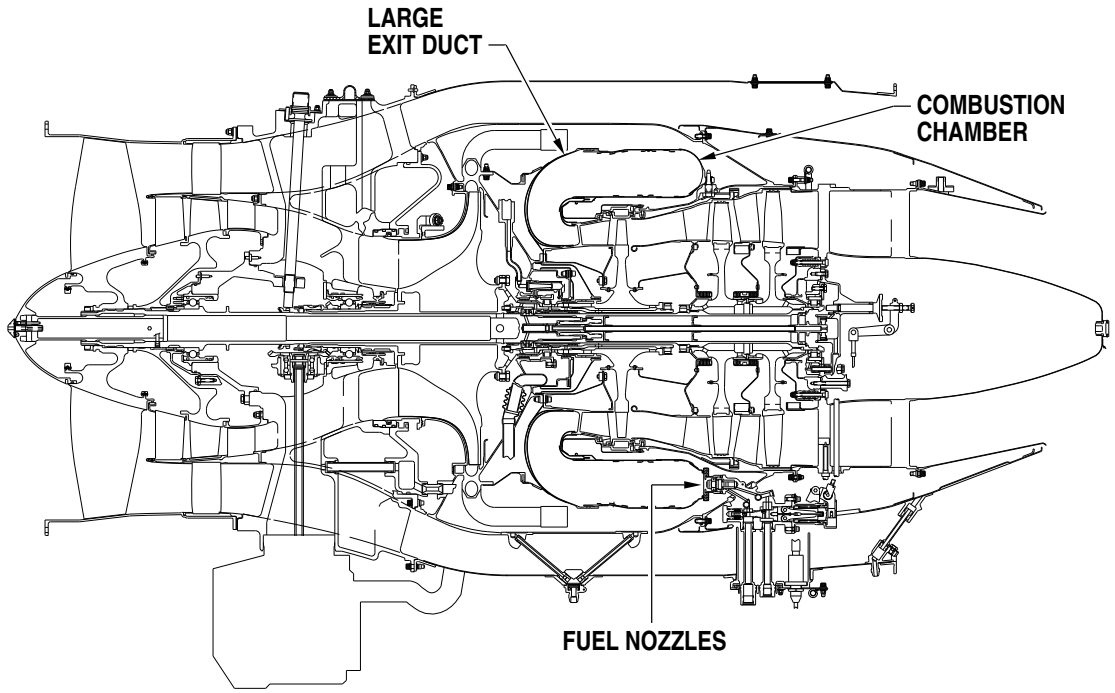

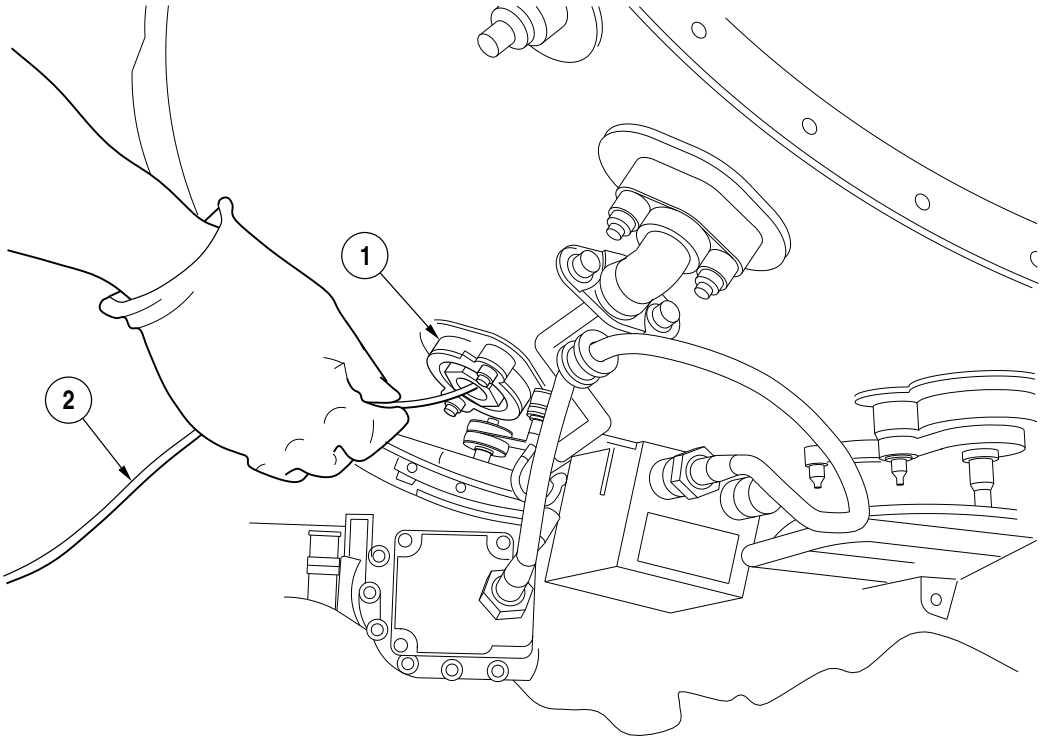

C64592B

Borescope Inspection of Fuel Nozzles, Combustion Chamber and Large Exit Duct (Typical)
Figure 606 (Sheet 1 of 2)

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Key to Figure 606

1. Spark Igniter Port
2. Borescope

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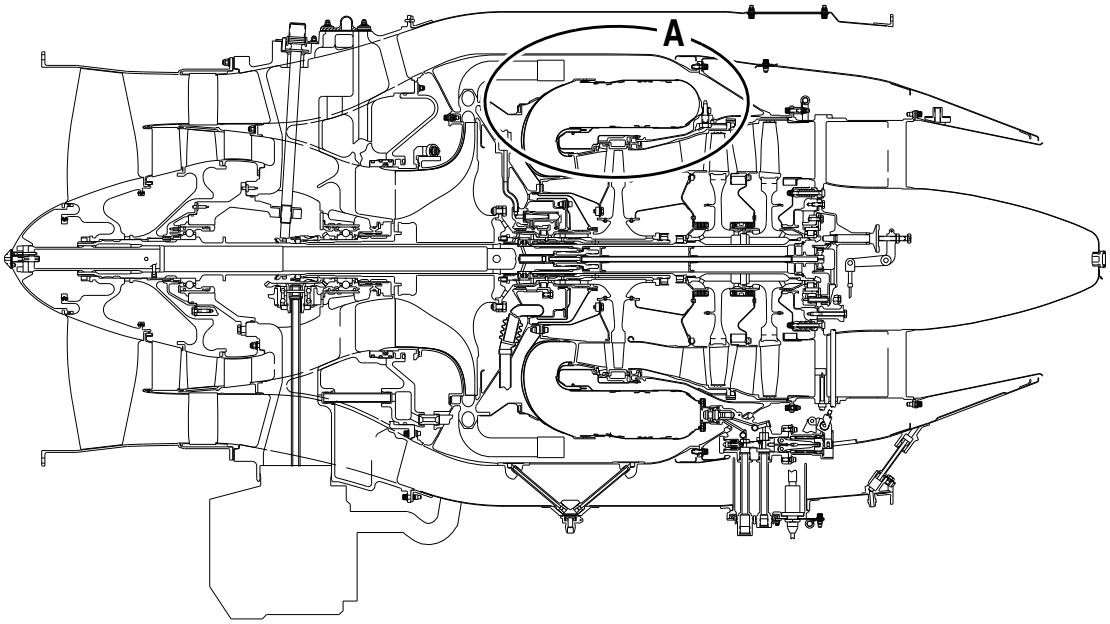

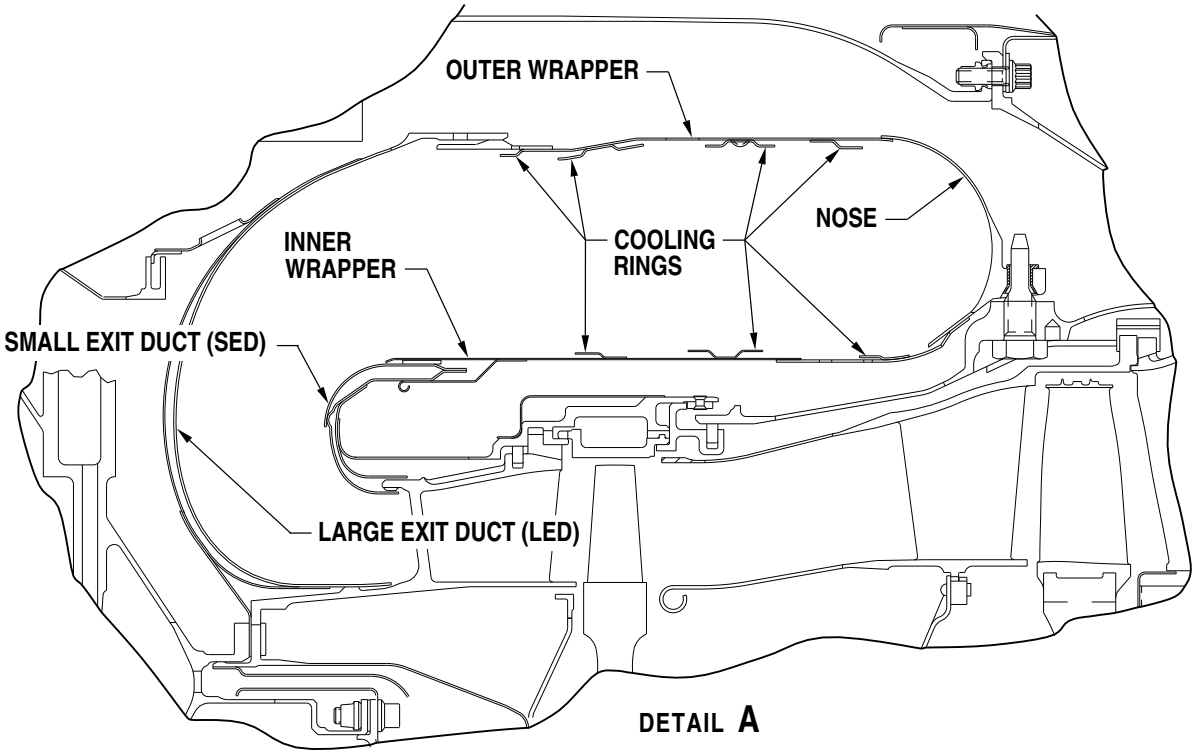

C243976

Borescope Inspection of Fuel Nozzles, Combustion Chamber and Large Exit Duct (Typical)
Figure 606 (Sheet 2)

P&WC Proprietary Information. Subject to the restriction on the title page.
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(3) Insert borescope tube (3) and inspect No. 4 bearing area for excessive oil wetting or coking.

NOTE: Minor oil residue is acceptable based on oil consumption being within limits (Ref. 72-00-00, Inspection/Check).

(4) Apply anti-galling compound (PWC06-032A) to threads of borescope port plug (2) and install plug in exhaust duct rear cone (2).

CAUTION: DO NOT EXCEED TORQUE VALUE STATED.

(5) Torque plug 25 to 35 lb.in. and lockwire.

J. HP Turbine Blades (Ref. Fig. 608)

(1) Access engine exhaust duct (Ref. Airframe Maintenance Manual).

(2) Insert borescope through exhaust duct struts and manipulate through LP turbine stator and rotor assemblies.

CAUTION: ROTATE WRENCH SLOWLY TO AVOID DAMAGE TO BORESCOPE TIP.

(3) Manually rotate HP compressor rotor using wrench (PWC31540) installed in splined starter-generator drive pad (Ref. 72-60-02, AGB EXTERNALS AND OIL PUMP- MAINTENANCE PRACTICES) and examine all HPT blades (Ref. 72-50-02, HP TURBINE ASSEMBLY - MAINTENANCE PRACTICES).

(4) Remove borescope carefully after completing inspection.

K. Fault Isolation

(1) DELETED.

TABLE 603, Fault Isolation for Borescope Use

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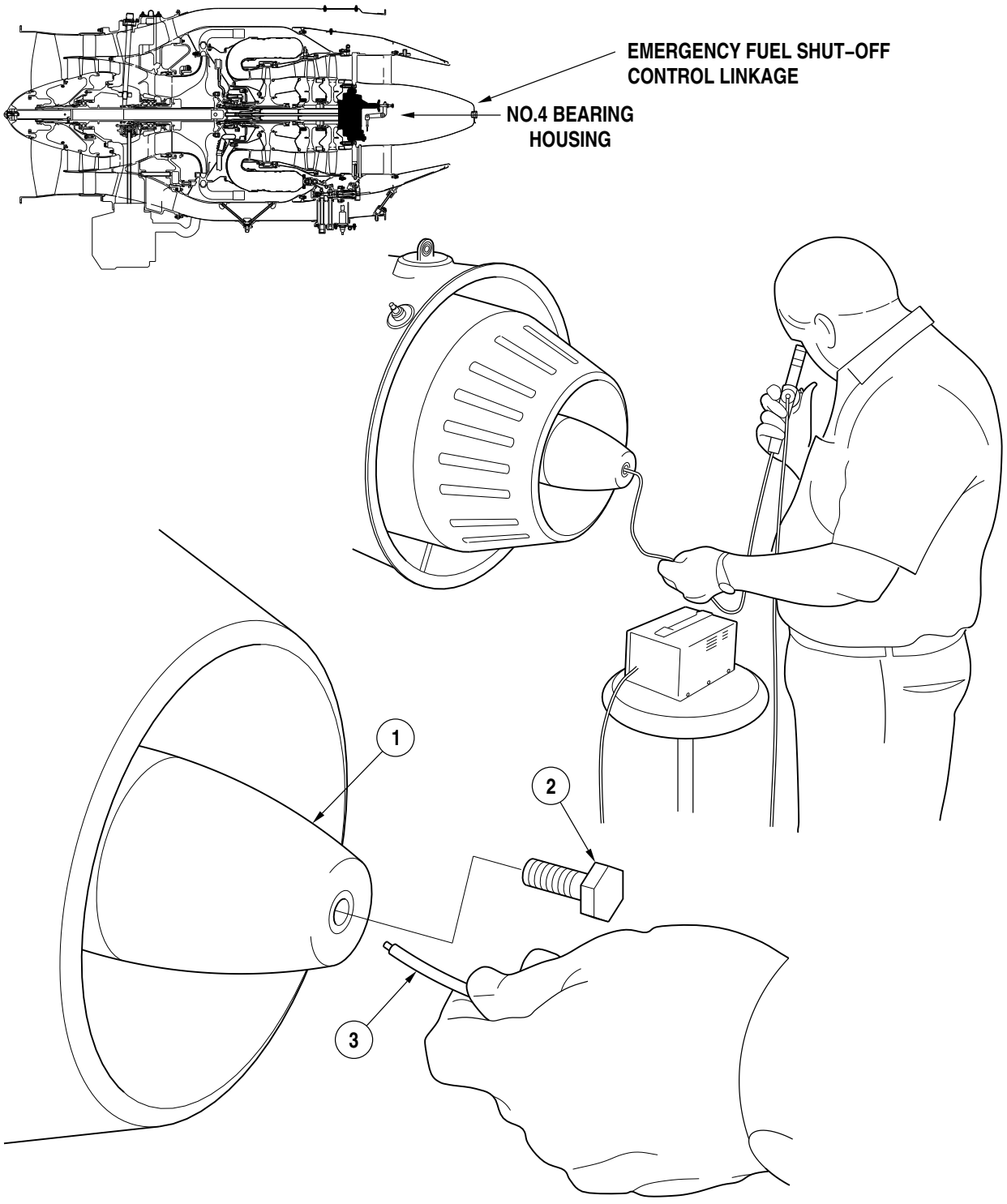

C243978

Borescope Inspection of No.4 Bearing Housing (Typical)
Figure 607

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Key to Figure 607

1. Exhaust Duct Rear Cone
2. Borescope Inspection Port Plug
3. Borescope

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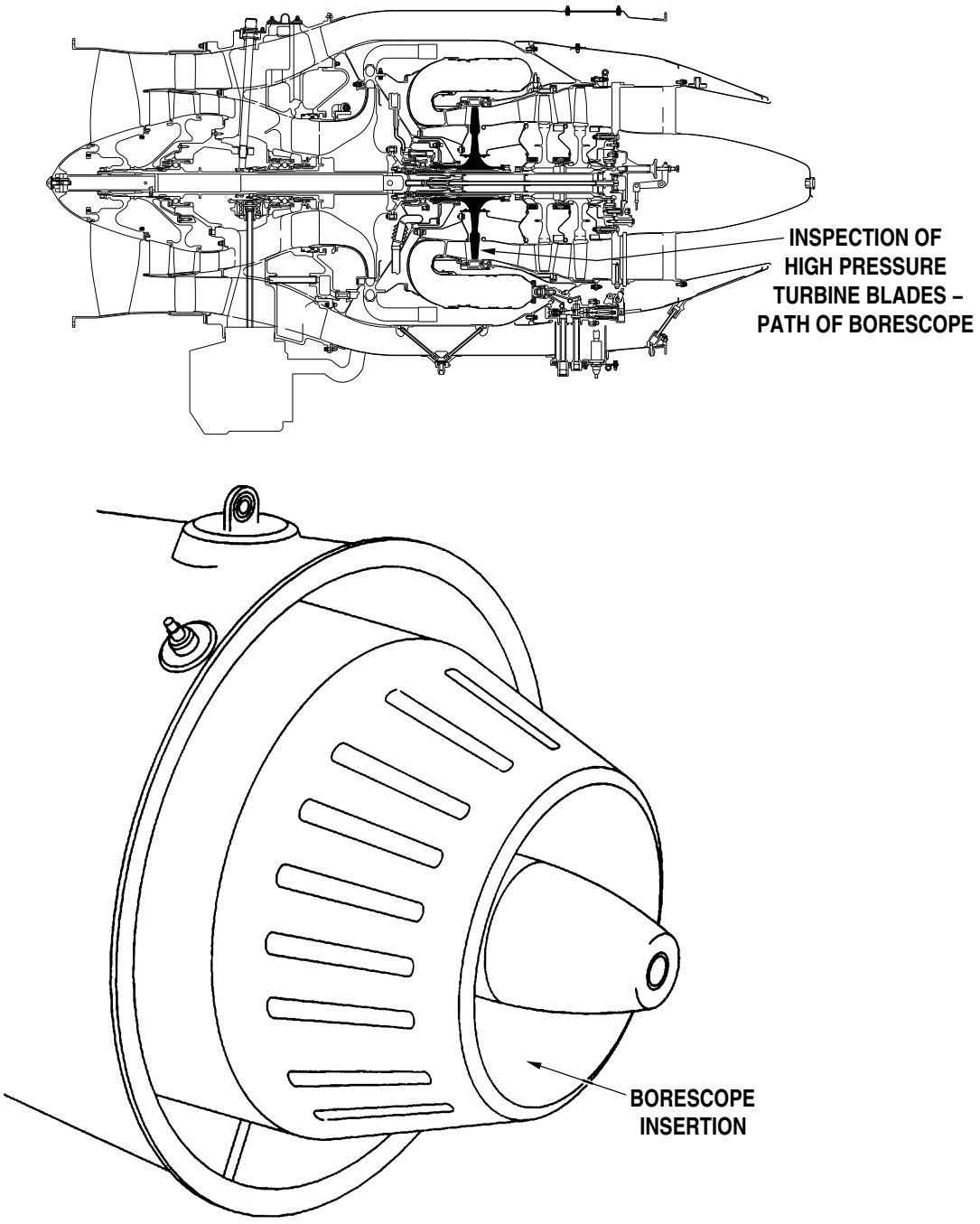

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Borescope Inspection of HPT Blades (Typical)
Figure 608

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LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
LEP	1	Feb 18/2011
	2	Feb 18/2011
Contents	1	Feb 18/2011
	2	Feb 18/2011
	3	Feb 18/2011
	4	Feb 18/2011
72-30-00	1	Oct 22/99
Description and Operation	2 blank	Oct 22/99
72-30-01	1	Oct 06/2006
Description and Operation	2 blank	Oct 06/2006
72-30-01	201	Feb 18/2011
Maintenance Practices	202	Feb 18/2011
	203	Feb 18/2011
	204	Feb 18/2011
	205	Feb 18/2011
	206	Feb 18/2011
	207	Feb 18/2011
	208	Feb 18/2011
	209	Feb 18/2011
	210	Feb 18/2011
	211	Feb 18/2011
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	213	Feb 18/2011
	214	Feb 18/2011
	215	Feb 18/2011
	216	Feb 18/2011
	217	Feb 18/2011
	218 blank	Feb 18/2011
72-30-02	1	Oct 22/99
Description and Operation	2	Oct 22/99
72-30-02	201	Apr 13/2001
Maintenance Practices	202	Apr 13/2001
72-30-03	1	Oct 22/99
Description and Operation	2	Oct 22/99
72-30-03	201	Feb 18/2011
Maintenance Practices	202	Feb 18/2011
	203	Feb 18/2011
	204	Feb 18/2011
	205	Feb 18/2011
	206	Feb 18/2011
	207	Feb 18/2011
	208	Feb 18/2011
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	224 blank	Feb 18/2011
72-30-04	1	Oct 22/99
Description and Operation	2	Oct 22/99
	3	Oct 22/99
	4 blank	Oct 22/99

P&WC Proprietary Information. Subject to the restrictions on the title page.

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
72-30-05	1	Oct 22/99
Description and	2	Oct 22/99
Operation		
72-30-05	201	Sep 28/2001
Maintenance	202	Sep 28/2001
Practices		
72-30-06	1	Oct 22/99
Description and	2	Oct 22/99
Operation		
72-30-06	201	Oct 22/99
Maintenance	202	Oct 22/99
Practices		
72-30-07	1	Oct 06/2006
Description and	2	Oct 06/2006
Operation	3	Oct 06/2006
	4 blank	Oct 06/2006
72-30-07	201	Oct 06/2006
Maintenance	202	Oct 06/2006
Practices	203	Oct 06/2006
	204	Oct 06/2006
	205	Oct 06/2006
	206 blank	Oct 06/2006

P&WC Proprietary Information. Subject to the restrictions on the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
COMPRESSOR SECTION - DESCRIPTION AND OPERATION	**72-30-00**
1. Compressor Section	1
LP COMPRESSOR CASE AND STATORS - DESCRIPTION AND OPERATION	**72-30-01**
1. LP Compressor Case and Stator Assemblies	1
LP COMPRESSOR CASE AND STATORS - MAINTENANCE PRACTICES	**72-30-01**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation (Heavy Maintenance only)	201
A. Removal of LP Compressor Case and Front Stator Assemblies	201
B. Installation of LP Compressor Case and Stator Assemblies	207
6. Cleaning/Painting	210
A. General	210
B. Compressor Wash	210
7. Inspection/Check	211
A. LP Compressor Case	211
B. LP Compressor Front Stator Assembly and Retaining Rivets	211
8. Approved Repairs	213
A. LP Compressor Case - Blade Rub Repair	213
B. LP Compressor Stator Assembly	213
C. LP Compressor Stator Assembly - Rivet Replacement	213
9. Fits, Clearances and Torque Loadings	213

P&WC Proprietary Information. Subject to the restrictions on the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
INTERMEDIATE CASE ASSEMBLY - DESCRIPTION AND OPERATION	**72-30-02**
1. Description	1
INTERMEDIATE CASE ASSEMBLY - MAINTENANCE PRACTICES	**72-30-02**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Approved Repairs	201
A. Engine Mount Pads - Threaded Inserts	201
B. Corrosion	201
LP COMPRESSOR ROTOR ASSEMBLIES- DESCRIPTION AND OPERATION	**72-30-03**
1. Description	1
A. LP Compressor Rotor Assemblies	1
B. Compressor Inlet Cone	1
LP COMPRESSOR ROTOR - MAINTENANCE PRACTICES	**72-30-03**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	202
5. Removal/Installation (Heavy Maintenance Only)	203
A. Removal of Inlet Cone Assembly	203
B. Installation of Inlet Cone Assembly	205
C. Removal of LP Compressor Rotor	205
D. Installation of LP Compressor Rotor	207

P&WC Proprietary Information. Subject to the restrictions on the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
LP COMPRESSOR ROTOR - MAINTENANCE PRACTICES (Cont'd)	**72-30-03**
E. Installation and Balance Weight Coding for Replacement, Serviced or Repaired LP Compressor Rotor	212
6. Adjustment/Test	214
A. On-Wing Engine Vibration Analysis and Trim Balance	214
7. Inspection/Check	214
A. Inspection of Inlet Cone	214
B. LP Compressor Booster Stage Rotor Blade Inspection	215
C. Inspection of LP Compressor Rotor Blades	215
8. Approved Repairs	219
A. LP Compressor Blades	219
9. Fits, Clearances and Torque Loadings	220
A. General	220
NO.1 BEARING AND N1 SPEED SENSING - DESCRIPTION AND OPERATION	**72-30-04**
1. LP Compressor Shaft, No.1 Bearing and N1 Speed Sensing	1
GAS GENERATOR CASE - DESCRIPTION AND OPERATION	**72-30-05**
1. Description	1
GAS GENERATOR CASE - MAINTENANCE PRACTICES	**72-30-05**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Inspection/Check	201
A. Procedure	201

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TABLE OF CONTENTS

SUBJECT	PAGE
HIGH PRESSURE COMPRESSOR ASSEMBLY - DESCRIPTION AND OPERATION	**72-30-06**
1. Description	1
HIGH PRESSURE COMPRESSOR ASSEMBLY - MAINTENANCE PRACTICES	**72-30-06**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Inspection/Check	201
A. Procedure	201
LP COMPRESSOR BLEED AIR SYSTEM - DESCRIPTION AND OPERATION	**72-30-07**
1. Compressor Bleed System	1
2. Bleed System Operation	1
COMPRESSOR BLEED VALVE - MAINTENANCE PRACTICES	**72-30-07**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Adjustment/Test	201
A. Rigging of Bleed Valve :	201

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COMPRESSOR SECTION - DESCRIPTION AND OPERATION

1. Compressor Section

The compressor section extends from the LP compressor case at the front of the engine through the engine intermediate case and into the forward part of the gas generator case. The compressor consists of two stages, a low pressure rotor assembly (fan), associated stators, inlet guide vanes and a high pressure centrifugal impeller and diffuser. A compressor bleed valve system is incorporated to bleed high pressure compressor air to the bypass duct, under certain flight conditions (Ref. 72-30-07). A full description of the compressor section is contained in the respective chapters.

LP COMPRESSOR CASE AND STATORS - DESCRIPTION AND OPERATION

1. LP Compressor Case and Stator Assemblies

The LP compressor case consists of an annular stainless steel housing with integral front and rear flanges.The rear flange is attached by self-locking nuts to studs on the intermediate case, while the front flange provides the means of attachment for the airframe supplied air intake cowling. Two engine front lifting brackets are located on the inside face of the rear flange, each side of the top center position. A support bracket for the is located offset to the right on top of the low compressor case; the front flange of the bracket is bolted to the compressor case front flange and the rear lugs of the bracket are secured to bosses on the intermediate case.

The stator assemblies, consisting of concentric inner and outer vane rings, divide and direct the air flow from the LP compressor. The vanes of the outer stator and front assemblies are brazed to inner and outer shroud rings. The vanes of the rear inner stator assembly are brazed to an inner shroud.

The front inner stator assembly has a single row of 52 guide vanes directing air flow from the fan rotor onto the booster stage. On JT15D-5 (Pre-SB7391) engines, each vane has two anti-icing air channels respectively parallel with and adjacent to the leading and trailing edges. On JT15D-5 (Post-SB7391) and JT15D-5R engines, anti-icing air channels are replaced with drilled anti-icing air holes. The outer shroud ring is riveted at the leading edge to the leading edge of the bypass vane ring inner shroud. The trailing edge fits into the rear inner stator and boost rotor outer shroud ring. To reduce air pressure loss, a baffle and static abradable seal are riveted to the inner shroud ring. The rotating member for the seal is located on the booster stage hub.

The rear inner stator assembly has a single row of 47 guide vanes directing air flow through the intermediate case to the high pressure compressor. The rear flange of the supporting shroud, which extends forward to form a shroud for the booster stage, is secured with nine self-locking nuts to intermediate case studs.

The bypass stator assembly has a single row of 60 equi-spaced vanes that direct airflow through the bypass duct. The outer shroud of the stator is riveted to the LP compressor case forward of Flange A .

The annular space contained within the front inner and rear inner stator outer shrouds and the inner shroud of the bypass stator forms a hot air anti-icing cavity.

LP COMPRESSOR CASE AND STATORS - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the LP compressor case and its stator assemblies.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC06-004	Anti-seize Compound
PWC09-003	Compound, Sealing, Silicone
PWC09-022	Compound, Jointing

3. Special Tools

   The special tools listed below are used in the following procedures.

Tool No.	Name
PWC31604	Puller

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation (Heavy Maintenance only)

   A. Removal of LP Compressor Case and Front Stator Assemblies (Ref. Fig. 201)

      (1) Remove inlet cone assembly (Ref. 72-30-03).

      (2) Remove T1 thermocouple probe (Ref. 77-20-01).

      (3) Drain engine oil tank (Ref. 79-00-01, OIL SYSTEM - SERVICING).

      (4) Remove pressure and bypass oil tubes between oil filter housing and oil pump (Ref. 79-20-02).

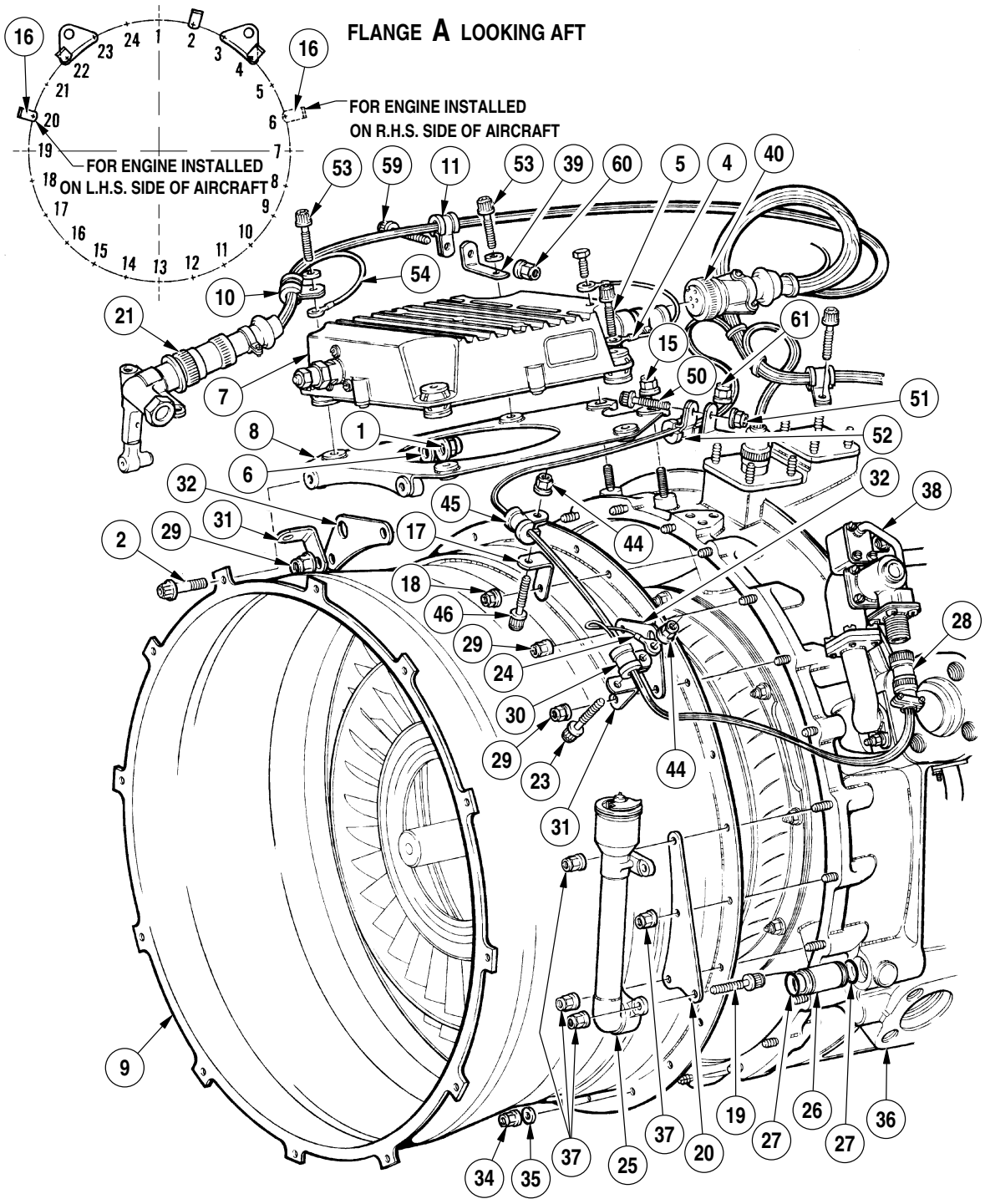
      (5) Disconnect T1 anti-icing air tube coupling nut from T1 thermocouple probe housing (Ref. 75-00-01).

      (6) For JT15D-5R engines, do the steps that follow:

         (a) Remove the fuel filter and the support bracket (Ref. 73-10-13).

         (b) Remove the fuel/oil heat exchanger (Ref. 73-10-14).

      (7) Remove LP compressor rotor balancing assembly (Ref. 72-30-03).



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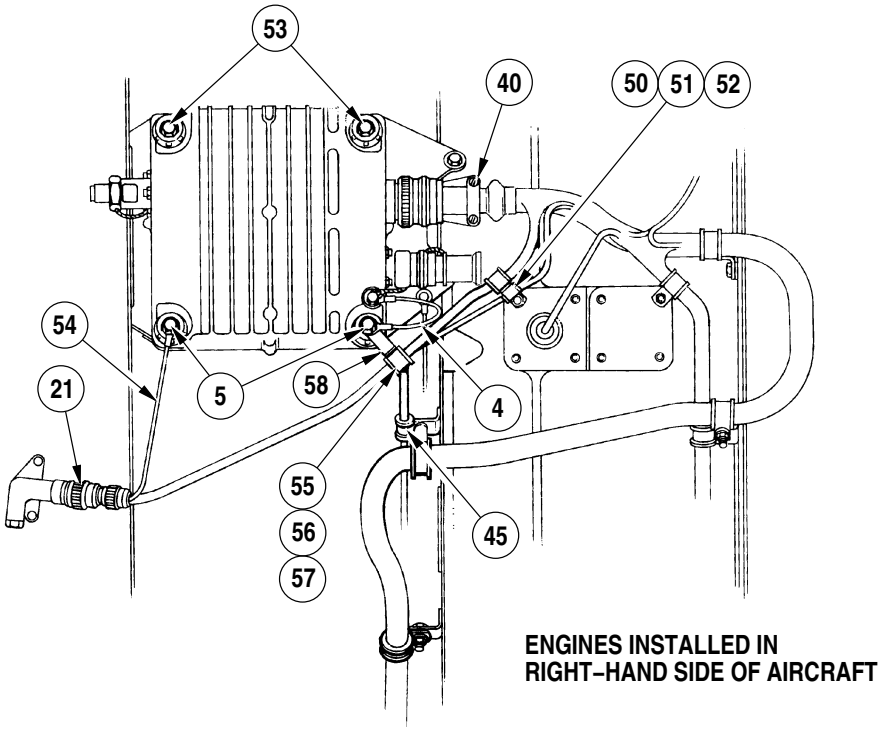
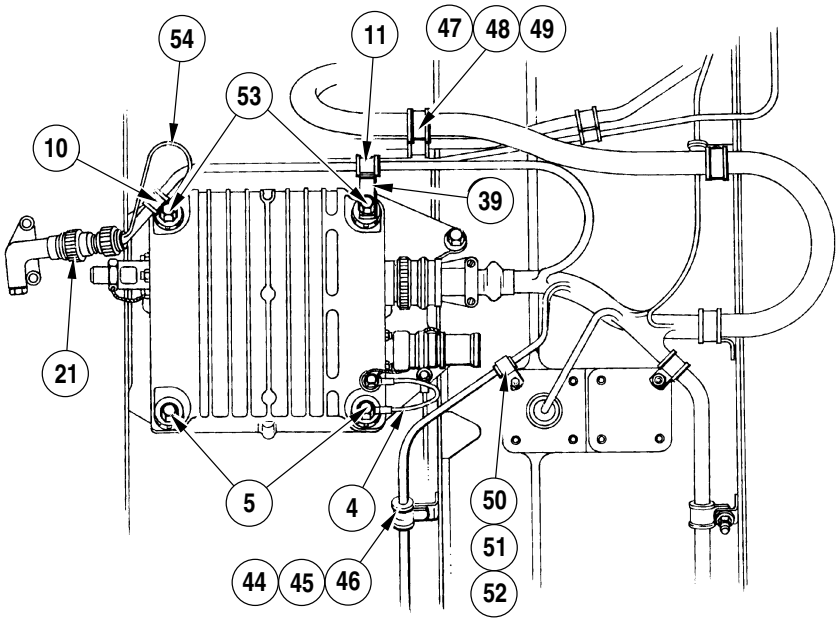
Removal/Installation - LP Compressor Case
Figure 201 (Sheet 1 of 3)

Key to Figure 201

1. Self-locking Nut
2. Bolt
3. Loop Clamp Assembly
4. Ground Strap Terminal
5. Bolt
6. Washer
7. EEC
8. EEC Support Bracket
9. LP Compressor Case
10. Loop Clamp Assembly
11. Loop Clamp Assembly
12. Self-locking Nut
13. Washer
14. Bolt
15. Self-locking Nut
16. Angle Bracket
17. Angle Bracket
18. Self-locking Nut
19. Bolt
20. Oil Filler Neck Plate
21. To Sensor Electrical Connector
22. Self-locking Nut
23. Bolt
24. Anti-icing Valve Ground Strap
25. Oil Filler Neck
26. Oil Transfer Tube
27. Preformed Packing
28. Harness Anti-icing Valve Connector
29. Self-locking Nut
30. Loop Clamp Assembly
31. Angle Bracket
32. Engine Lifting Bracket
33. Angle Bracket
34. Self-locking Nut
35. Washer
36. Intermediate Case
37. Self-locking Nut
38. Anti-icing Solenoid Valve
39. Angle Bracket
40. Input/Output Electrical Connector
41. LP Compressor Stator Assemblies
42. Puller
43. Spring Pin
44. Self-locking Nut
45. Loop Clamp Assembly
46. Bolt
47. Self-locking Nut
48. Bolt
49. Loop Clamp Assembly
50. Bolt
51. Self-locking Nut
52. Loop Clamp Assembly
53. Bolt
54. Ground Strap
55. Bolt
56. Self-locking Nut
57. Loop Clamp Assembly
58. Angle Bracket
59. Bolt
60. Self-locking Nut
61. Self-locking Nut



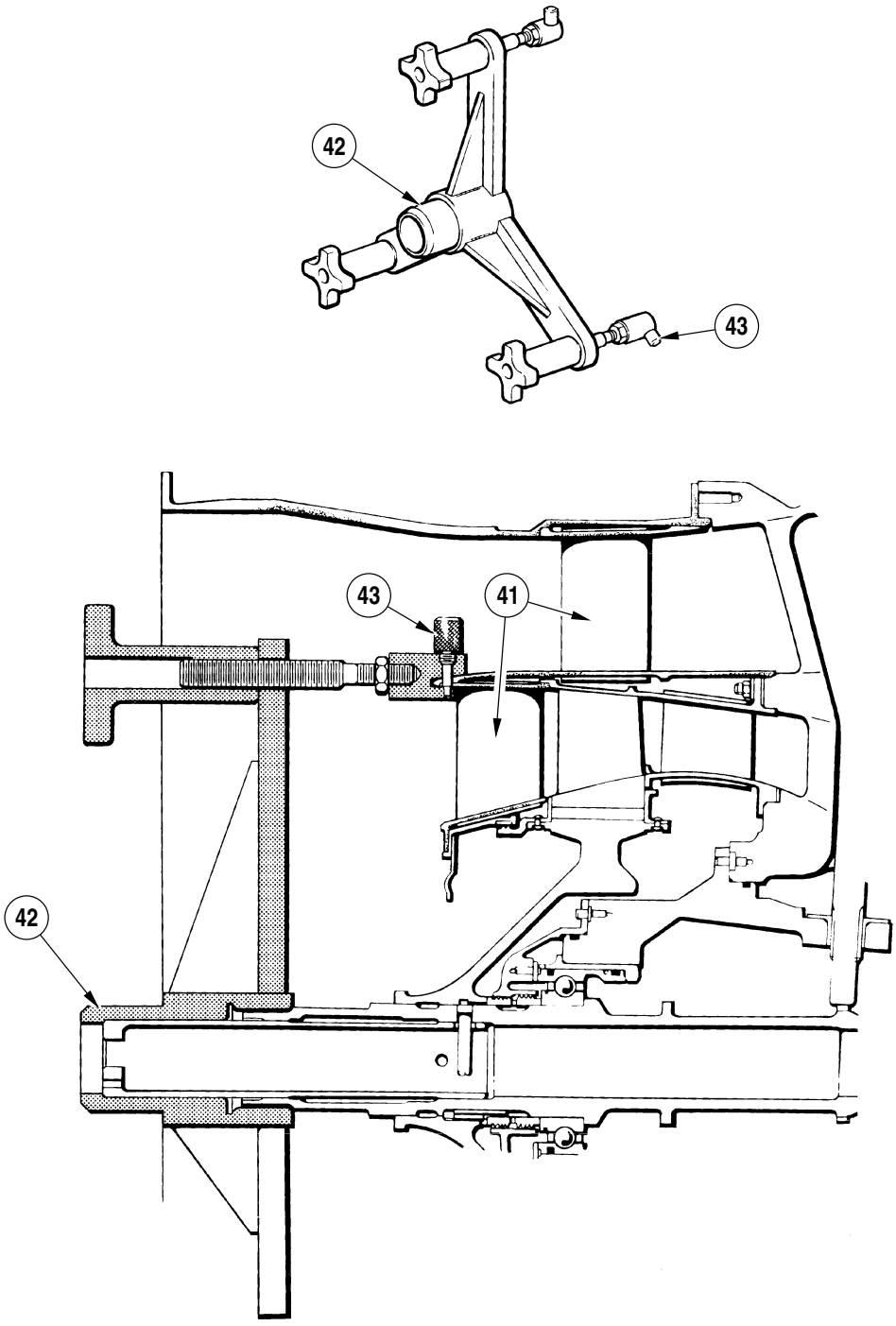
ENGINES INSTALLED IN
RIGHT–HAND SIDE OF AIRCRAFT



ENGINES INSTALLED IN
LEFT–HAND SIDE OF AIRCRAFT

C11407

Removal/Installation - LP Compressor Case
Figure 201 (Sheet 2)



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Removal/Installation - LP Compressor Case
Figure 201 (Sheet 3)

CAUTION: PROTECT AND SUPPORT ENGINE WIRING HARNESS CABLES AND CONNECTORS WHEN DISCONNECTED.

(8) For all engines installed on left-hand side of aircraft, proceed as follows:

(a) Disconnect airframe electrical supply connector at engine right-hand side.

(b) Remove self-locking nut (44), bolt (46) and clamp assembly (45) from bracket (17) at flange A.

(c) Remove self-locking nut (47), bolt (48) and triple clamp assembly (49) from bracket at flange A.

(d) Remove self-locking nut (51), bolt (50) and clamp assembly (52) from bracket (17) on intermediate case.

(e) Disconnect input/output electrical connector (40) from EEC (7).

(f) Disconnect electrical connector (21) from To sensor installed at top right-hand side of airframe intake duct.

(g) Remove two bolts (53) from right-hand side of EEC, remove ground lead terminal (54), two loop clamp assemblies (10) and (11) and bracket (39).

(h) Disconnect anti-icing valve electrical connector (28) from valve (38).

(i) Remove self-locking nut (44), bolt (23) and clamp assembly (30) from bracket (31) on flange A.

(j) Remove two bolts (5) and washers from left-hand side of EEC and carefully remove EEC from bracket on LP compressor case.

(9) For engines installed on right-hand side of aircraft, proceed as follows:

(a) Disconnect airframe electrical supply connector at engine left-hand side.

(b) Remove self-locking nuts (44), bolts (23) and (46) and two clamp assemblies (30) and (45) from brackets (17) and (31) on flange A.

(c) Disconnect input/output electrical connector (40) from EEC (7).

(d) Disconnect electrical connector (21) from To sensor installed at top left-hand side of airframe intake duct.

(e) Remove two bolts (5) from left-hand side of EEC. Remove bolt (55) and self-locking nut (56) retaining loop clamp assembly (57) to bracket (58) and remove bracket.

(f) Remove bolt (50) and self-locking nut (51) from bracket securing double loop clamp assembly (52) at intermediate case. Remove loop clamps from stud.

(g) Disconnect anti-icing valve electrical connector (28) from valve (38).

(h) Remove two bolts (5) and washers from left-hand side of EEC and carefully remove EEC from bracket on LP compressor case.

(10) Remove two self-locking nuts (1), washers (6) and bolts (2) securing EEC mount bracket (8) to LP compressor case front flange; remove two self-locking nuts (15) and washers securing rear of bracket to intermediate case (36). Remove bracket.

NOTE: Depending on whether engine is mounted on left- or right-hand side of aircraft, bracket (16) is positioned on stud 6 for right-hand or stud 20 for left-hand installation.

(11) Remove four self-locking nuts (29) securing two engine lifting brackets (32) and two right angle brackets (31) at flange A; remove self-locking nut (18) and bracket (17). Remove self-locking nut and remaining bracket (16).

NOTE: Ensure oil is drained below level of oil filler tube boss on intermediate case.

(12) Remove four self-locking nuts (37) and bolt (19) securing plate (20) and oil filler neck to flange A. Withdraw oil filler neck (25) and transfer tube (26) together from boss on intermediate case. Remove plate (20) from flange A and transfer tube (26) from filler neck, remove and discard preformed packings (27) from transfer tube.

(13) Remove remaining 16 self-locking nuts (34), washers (35), and two spacers securing LP compressor case (9) and stator assemblies to intermediate case (36).

NOTE: Spacer location depends on location of oil filler neck.

(14) Locate three offset holes on LP compressor case front inner stator. Install puller (42) (PWC31604) onto LP compressor shaft and position three shoe assemblies at offset hole locations. Insert three spring pins (43) on shoe assemblies into offset holes.

(15) Screw three shoe assemblies through ring assembly on puller (42) to remove LP compressor case (9) with stator assemblies (41) from intermediate case.

(16) Place LP compressor case with rear flange down on workbench and remove puller (42).

B. Installation of LP Compressor Case and Stator Assemblies (Ref. Fig. 201)

NOTE: For fits and clearances and torque load values, refer to Table 201 and Figure 204.

(1) For Pre-SB7593: Apply an even coating of silicone sealing compound (PWC09-003) to mating faces of intermediate case (36) and LP compressor case (9).

(2) For Post-SB7593: Apply an even coating of jointing compound (PWC09-022) to mating faces of intermediate case (36) and LP compressor case (9).

(3) Carefully install LP compressor case (6) onto intermediate case (36). Check that drain holes are at bottom.

(4) At stud positions 2,3,4 (6, 7, 8 or 18, 19, 20 as applicable), 22 and 23, install eight slave washers and nuts. At remaining fifteen positions, install washers (35), two spacers and self-locking nuts (34).

NOTE: Spacer locations depend on location of oil filler neck.

CAUTION: APPLY UNIFORM PRESSURE EQUALLY DISTRIBUTED TO ENSURE SHROUD SPIGOT CIRCUMFERENCE OF COMPRESSOR CASE LOCATES CORRECTLY WITH OUTER SHROUD RING SPIGOT OF OUTER STATOR ASSEMBLY.

(5) Gradually apply small incremental torque loads to alternate self-locking nuts , 180 degrees apart, drawing mating faces of LP compressor case and intermediate case together evenly, until fully in contact.

(6) Remove previously installed slave nuts and washers; install the following parts:

(a) Right-hand lifting bracket (32) on studs 22 and 23.

(b) Angle bracket (31) on stud 22 over lifting bracket (32).

(c) Left-hand lifting bracket (32) on studs 3 and 4.

(d) Angle bracket (31) on stud 4 over lifting bracket (32).

(e) Angle bracket (17) on stud 2.

(f) Angle bracket (16) on stud 20 for engine installed on left-hand side of aircraft or stud 6 for engine installed on right-hand side of aircraft.

(g) Secure brackets with six self-locking nuts (29) and tighten.

(7) Apply final torque of 75 to 85 lb.in. to alternate self-locking nuts , 180 degrees apart.

(8) Position EEC support bracket (8) rear on two studs located on upper surfaces of intermediate case. Align bracket from bolt holes with mating holes in LP compressor case front flange (rear face of flange). Install two bolts (2) through bracket/flange and secure with two washers (6) and self-locking nuts (1). Tighten and torque nuts 75 to 85 lb.in.

(9) Install two self-locking nuts (15) on rear studs locating bracket. Tighten and torque nuts 32 to 36 lb.in.

(10) For engines installed on left-hand side of aircraft, proceed as follows:

(a) Install new preformed packings (27) on transfer tube (26) and install plate (20) on flange A studs 6, 7 and 8.

(b) Install one end of transfer tube (26) into oil filler neck; insert other end into oil inlet boss on intermediate case while locating filler neck mounting bracket on studs 6 and 8. Secure filler neck and plate to flange A with three self-locking nuts (37). Install bolt (19) and self-locking nut (37) securing filler neck to plate. Tighten all nuts and torque nuts 75 to 85 lb.in.

(c) Connect electrical connector (21) to To sensor installed at top right-hand side of airframe duct.

(d) Carefully position engine electronic control (7) assembly on support bracket (8). On right-hand side of EEC, install angle bracket (39) on bolt and install bolt in rear EEC cover hole. Install loop clamp assembly (10) and ground terminal (54) on bolt (53) and install bolt in front EEC cover hole. On left-hand side of EEC, install washer and bolt (5) in front hole of EEC cover. Install ground terminal (4) and washer on bolt (5) and install bolt in EEC rear cover hole. Tighten and torque bolts 32 to 36 lb.in.

(e) Secure To harness loop clamp assembly (11) to bracket (39) with bolt (59) and self-locking nut (60). Tighten and torque nut 32 to 36 lb.in.

(f) Connect anti-icing valve electrical connector (28) to valve (38). Secure loop clamp assemblies (30) and (45) to brackets (17) and (31) at flange A with bolts (23) and (46) and self-locking nuts (44). Tighten and torque nuts to 32 to 36 lb.in.

(g) Secure loop clamp assembly (52) to bracket on intermediate case with bolt (50) and self-locking nut (51). Tighten and torque nut to 32 to 36 lb.in.

(h) Install electrical input/output connector (40) to EEC (7).

(i) Secure three loop clamp assemblies (49) to bracket (16) at flange A with bolt (48) and self-locking nut (47). Tighten and torque nut 32 to 36 lb.in.

(j) Connect electrical supply connector to airframe at right-hand side of aircraft.

(11) For engines installed on right-hand side of aircraft, proceed as follows:

(a) Install new preformed packings (27) on transfer tube (26) and install plate (20) on flange A studs 18, 19 and 20.

(b) Install one end of transfer tube (26) into oil filler neck; insert other end into oil inlet boss on intermediate case while locating filler neck mounting bracket on studs 18 and 20. Secure filler neck and plate to flange A with three self-locking nuts (37). Install bolt (19) and self-locking nut (37) securing filler neck to plate. Tighten all nuts and torque nuts 75 to 85 lb.in.

(c) Connect electrical connector (21) to To sensor installed at top right-hand side of airframe duct.

(d) Carefully position engine electronic control (7) assembly on support bracket (8). On left-hand side of EEC, install angle bracket (58) and ground terminal (4) on bolt (5) and install bolt in rear EEC cover hole. Install ground terminal (54) on bolt (5) and install bolt in front EEC cover hole. On right-hand side of EEC, install two bolts (53) and washers in EEC cover holes. Tighten and torque bolts 32 to 36 lb.in.

(e) Secure To harness loop clamp assembly (57) to bracket (58) with bolt (55) and self-locking nut (56). Tighten and torque nut 32 to 36 lb.in.

(f) Secure two loop clamp assemblies (45) to bracket (17) at flange A with bolt (46) and self-locking nut (44). Tighten and torque nut 75 to 85 lb.in.

(g) Secure two loop clamp assemblies (52) to stud on intermediate case with self-locking nut (51). Tighten and torque nuts to 75 to 85 lb.in.

(h) Install electrical input/output connector (40) to EEC (7).

(i) Secure loop clamp assemblies (30) to bracket (31) at flange A with bolt (23) and self-locking nut (44). Tighten and torque nut 32 to 36 lb.in.

(j) Connect electrical supply connector to airframe at left-hand side of aircraft.

(12) Install LP compressor rotor balancing assembly (Ref. 72-30-03).

(13) For JT15D-5R engines, do the steps that follow:

(a) Install the fuel filter and the support bracket (Ref. 73-10-13).

(b) Install the fuel/oil heat exchanger (Ref. 73-10-14).

(14) Install pressure and bypass oil tubes between oil filter housing and oil pump (Ref. 79-20-02).

(15) Fill engine oil system (Ref. 79-00-01, OIL SYSTEM - SERVICING).

(16) Install T1 probe and housing (Ref. 77-00-01).

(17) Install inlet cone assembly (Ref. 72-30-03).

(18) If a new or repaired LP compressor stator assembly was installed, perform required ground checks (Ref. 71-00-00, ADJUSTMENT/TEST).

6. Cleaning/Painting

A. General

Field cleaning consists of internal washing of the compressor and internal and external washing of the engine bypass duct.

B. Compressor Wash

Perform compressor desalination wash (Ref. 71-00-00, CLEANING).

7. Inspection/Check

A. LP Compressor Case

(1) Inspect LP compressor case for cracks, indents and general condition.

(2) Inspect for damage at flanges and adjacent to stud/bolt holes.

(3) Inspect LP compressor case for scoring in coating or metal. Fan blade rub on paint only is allowable.

(4) If fan blade rub scoring is evident on metal, measure minimum wall thickness of case using a suitable micrometer:

(a) Minimum wall thickness is 0.160 inch. Reject LP compressor case with damage exceeding this limit.

(b) If scored area has acceptable wall thickness, refer to Paragraph 8. for repair.

B. LP Compressor Front Stator Assembly and Retaining Rivets (Ref. Fig. 202)

(1) Inspect outer vanes for impact damage. Nicks and dents to a depth of 0.045 inch at leading edges and 0.025 on trailing edges may be blended. Leading and trailing edge radii must be restored and notch effects must be removed and blended to minimum radius of 0.125 inch.

(2) LPC inner stator only: one crack per airfoil is permitted. The crack must be of hairlike type and must not exceed a maximum length of 0.396 inch.

(3) Shallow dents or bends are permitted on leading edges if smooth and not exceeding 0.060 inch displacement.

(4) Inspect front inner vanes for impact damage. Nicks and dents to a depth of 0.045 inch at leading edge and 0.020 inch at trailing edge may be blended out. Leading and trailing edge radii must be restored and notch effects must be removed and blended to a minimum radius of 0.125 inch.

(5) Inspect LP compressor stator assembly retaining rivets:

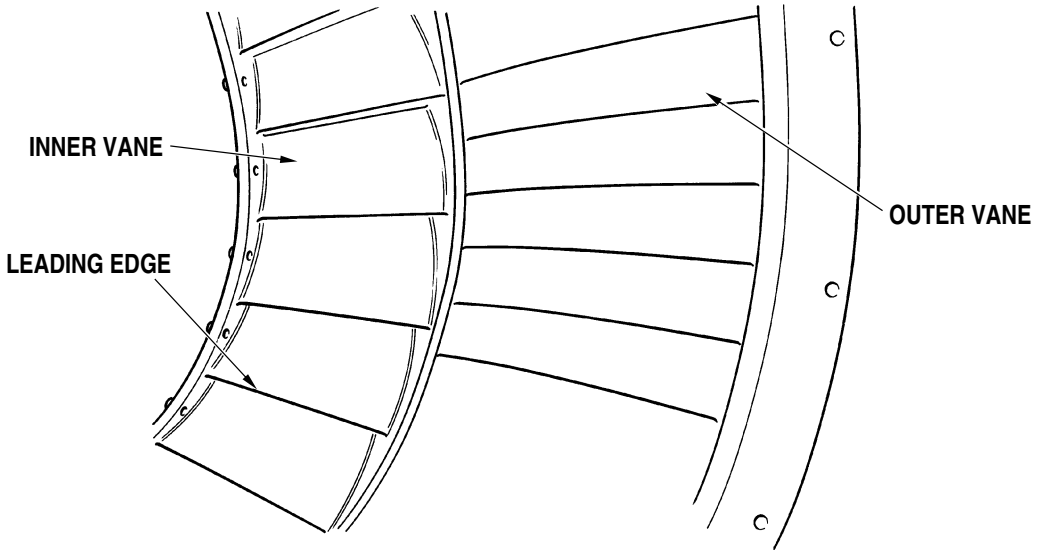
(a) Verify all 24 rivets are in place. Check rivets for looseness.

(b) For Post-SB7369:

1 If the stator assembly exhibits any evidence of vane bowing or bending as a result of an impact, replace all 24 rivets (Ref. Para. 8.C.).

2 If there are loose or missing rivets and no evidence of stator impact damage, replace individual loose or missing rivets (Ref. Para. 8.C.).

(6) Inspect stator assemblies for corrosion. Scattered pits up to 0.020 inch and clusters up to 0.010 inch are allowable. Stator assemblies with corrosion exceeding these limits must be returned to an approved overhaul facility for possible repair.



C11398

LP Compressor Stator Assemblies - Inspection
Figure 202

8. Approved Repairs

A. LP Compressor Case - Blade Rub Repair

(1) Remove inlet cone and LP compressor rotor (Ref. 72-30-03).

(2) Repair fan blade rub scoring on case by blending. Inspect blended areas with fluorescent penetrant. Reject cases with indication of cracks.

(3) Polish scored area to remove heat discoloration marks and loose paint. Apply aluminized epoxy enamel (PWC05-037) or available airframe standard epoxy enamel to repaired area.

(4) Install LP compressor rotor and inlet cone (Ref. 72-30-03).

B. LP Compressor Stator Assembly

NOTE: For repair limits, refer to Para. 7.B., preceding.

(1) Mask undamaged vanes for protection.

(2) Blend out sharp bottom damage to outer and inner vanes using small hand files and stones. Nicks and dents in damaged areas must be removed, and leading and trailing edge profiles must be maintained after repair.

(3) Subject repaired areas to dye check or fluorescent penetrant inspection.

C. LP Compressor Stator Assembly - Rivet Replacement

CAUTION: DO NOT DRILL THROUGH MANUFACTURED HEAD.

(1) Remove manufactured heads of 24 rivets retaining stator assembly to LP compressor case (Ref. Fig. 203):

(a) Use No.53 (0.0595 in. dia.) drill for Pre-SB7352, Pre-SB7335, Post-SB7335 LP compressor stators with 0.0625 inch rivets, and Pre-SB7264 LP compressor stator configurations.

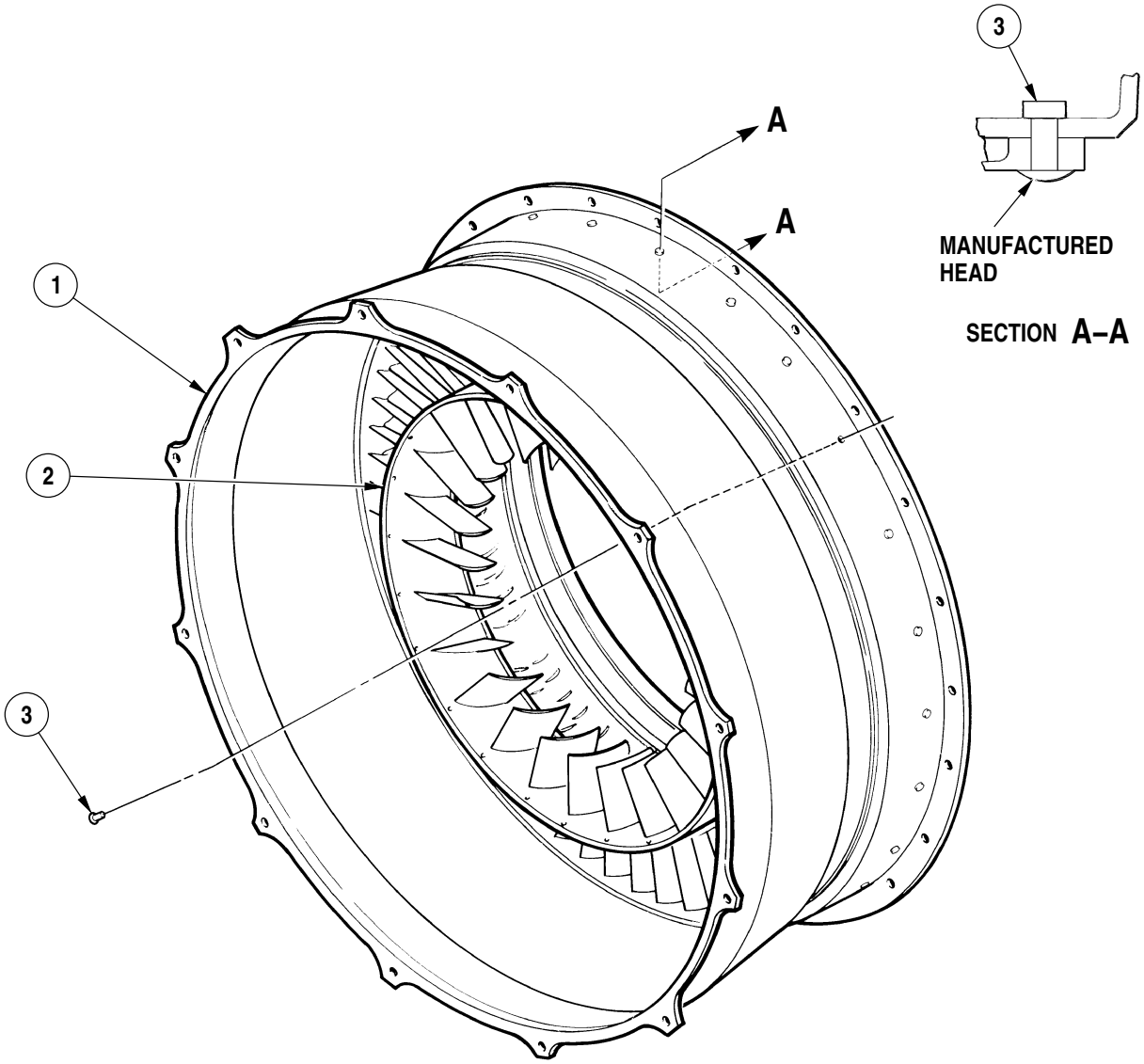
(b) For Post-SB7264, Post-SB7352, Post-SB7369 LP compressor stators and Post-SB7335 LP compressor stators with 0.125 inch rivets, use No. 31 (0.1200 in. dia.) drill.

(2) Remove 24 rivets using a suitable punch.

(3) Install 24 new rivets with manufactured head inboard. Upset rivets to form head on outside of case.

9. Fits, Clearances and Torque Loadings

A. Refer to Table 201 and Figure 204.



C22075

LP Compressor Stator Assembly - Rivet Replacement
Figure 203

Key to Figure 203

1. LP Compressor Case
2. LP Compressor Stator Assembly
3. Rivet

TABLE 201, FITS AND CLEARANCES

REF. NO.	Name	Dim. for Ref. (inches) Min.	Dim. for Ref. (inches) Max.	Limits (inches) Min.	Limits (inches) Max.	Limits (inches) Replace
1240	Stator, LP Compressor Assembly	14.4530	14.4570	0.0020	0.0040T	
	Stator, LP Compressor, Front Inner, Assembly	14.4550	14.4570			
1241	Case, Intermediate, Assembly	20.8100	20.8140	0.0000	0.0068T	
	Case, LP Compressor	20.8140	20.8168			
1248	Rotor, LP Compressor, Booster			0.0200 Radial Tip	0.0410 Clearance	
	Stator, LP Compressor, Inner, Assembly					
1252	Hub, Rotor, LP Compressor	0.1575	0.1595	0.0021	0.0061	
	Key, Square	0.1534	0.1554			
1253	Shaft, LP Compressor	0.1574	0.1594	0.0020	0.0060	
	Key, Machine	0.1534	0.1554			
1328	Stator, Compressor, Inner, Front	14.4560	14.4580	0.001T	0.0060T	
	Stator, Compressor, Bypass	14.4520	14.4550			

TABLE 202, TORQUE AND STRETCH

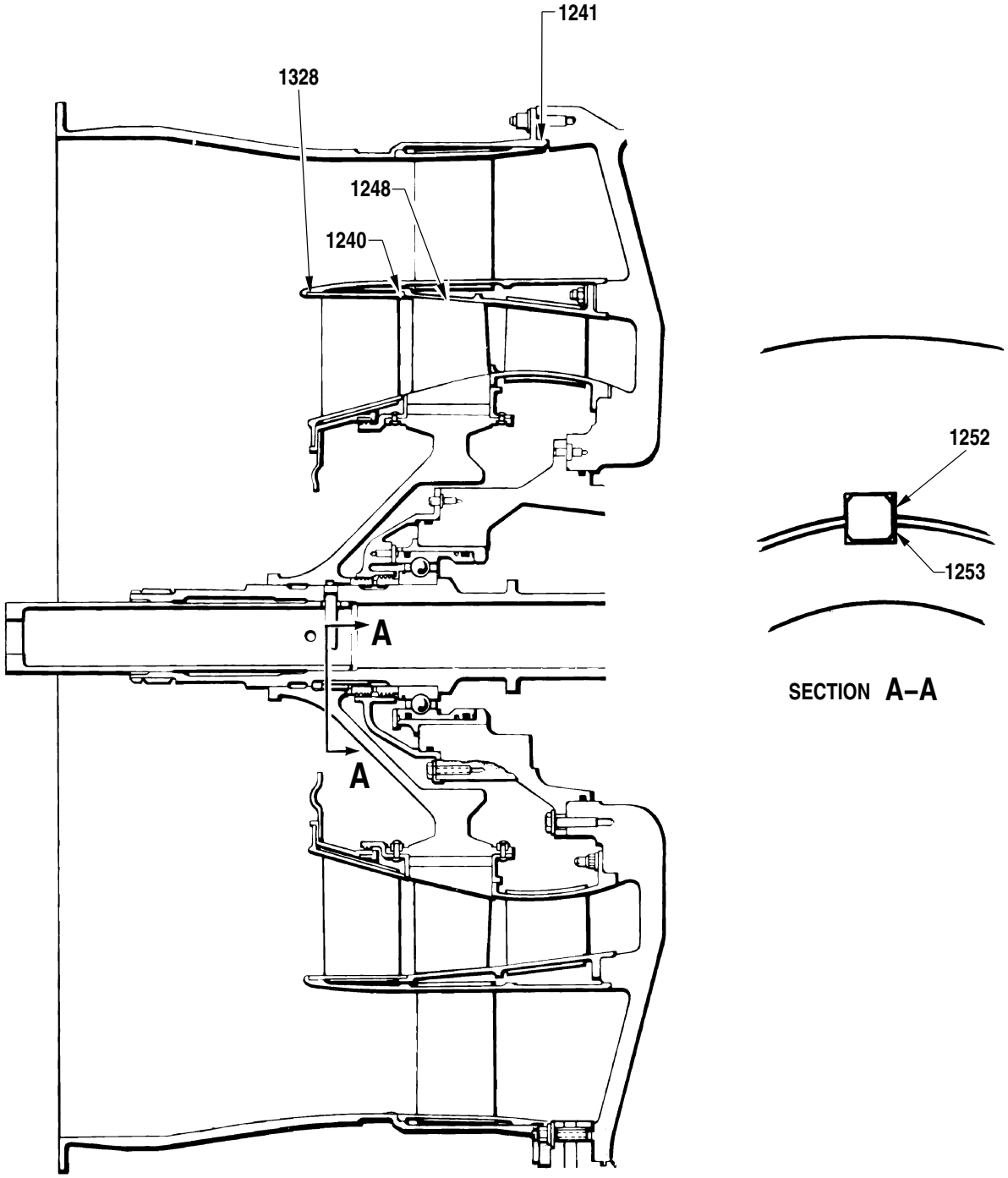
REF. NO.	Name	Limits Min.	Limits Max.
	Not Applicable		

TABLE 203, SPRING PRESSURE

REF. NO.	Name	Limits Min.	Limits Max.
	Not Applicable		

TABLE 204, SPECIAL ASSEMBLY

REF. NO.	Name	Limits Min.	Limits Max.
	Not Applicable		



JT15D-5 Shown, JT15D-5R Similar

C21488

Fits, Clearances and Torque Loadings
Figure 204

INTERMEDIATE CASE ASSEMBLY - DESCRIPTION AND OPERATION

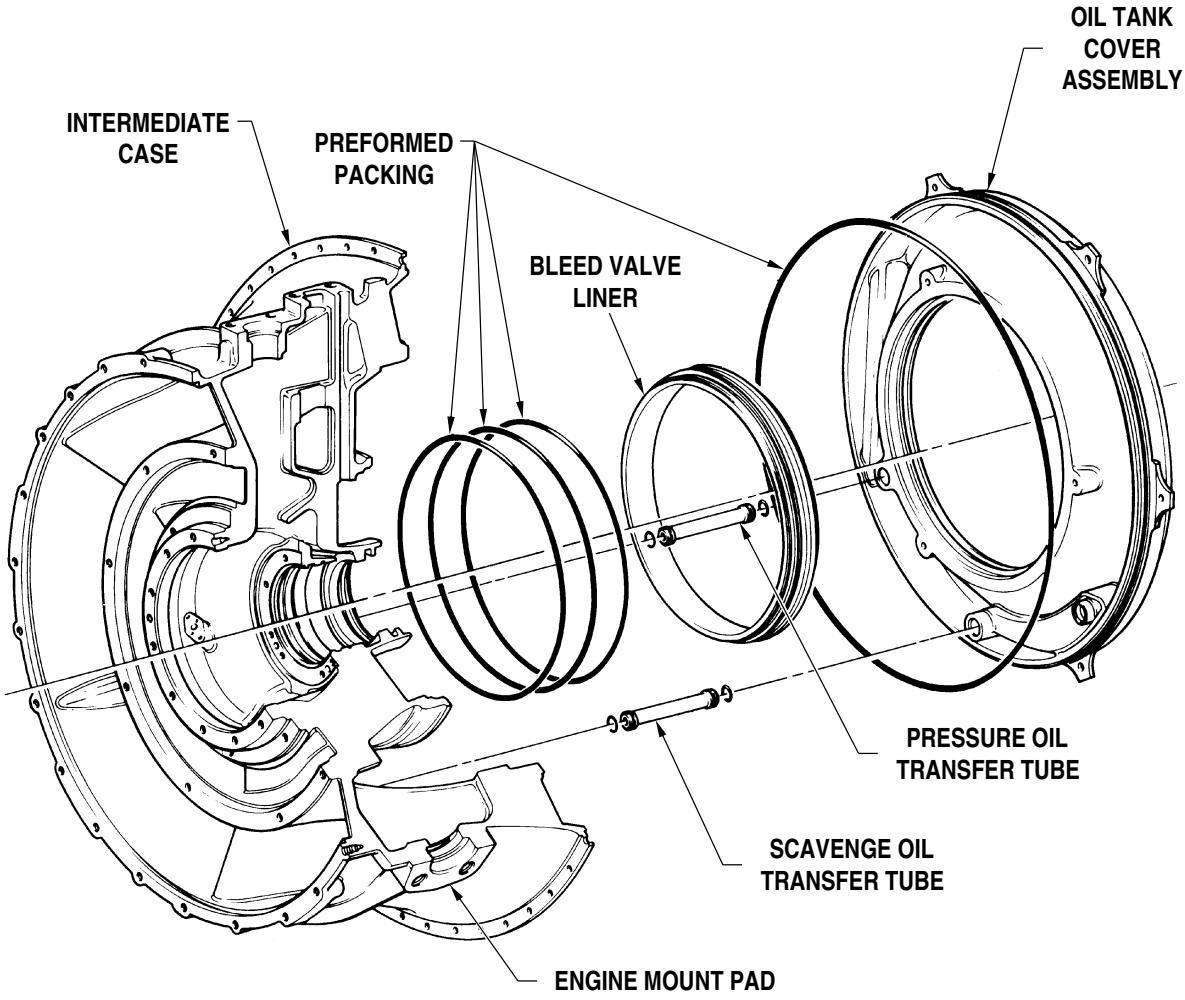
1. Description (Ref. Fig. 1)

The intermediate case assembly consists of a machined magnesium casting which provides passage for primary and bypass airflow through concentric annular passages. The case is the main structural member of the engine; it supports the LP compressor case at flange A, the bypass duct at flange B and, at its inner rear flange, the gas generator case. The accessory gearbox is suspended from the intermediate case. Primary airflow passes through the inner passage to the HP compressor impeller, while secondary airflow passes through the outer passage to the bypass duct. The annular passage walls are joined by six equally spaced struts in the outer passage and airfoil guide struts in the inner passage. The outer and inner struts are located on common radial axes. All outer (bypass) struts, and the struts in the 6 and 12 o'clock positions are hollow.

The outer wall of the primary passage and the inner wall of the bypass passage are joined at the front and diverge rearward to form an annular cavity. The cavity is sealed at the rear by a cover to form the engine oil tank. The inner diameter of the cover locates over the bleed valve liner. The oil filler neck and transfer tube are located at either the 4 or 8 o'clock positions to suit the engine installation. The oil filler neck is secured to flange A studs and a support plate.

The bore at the rear of the intermediate case supports the No. 2 oil damped ball bearing and the static member of its air seal, while the front face of the bore supports the No.1 bearing housing assembly. The housing assembly projects rearward to form an integral platform supporting the N1 sensor which extends up through the front pad at the 12 o'clock position on the intermediate case.

Four mount pads on the outer wall are in line with the four struts located 30 degrees above and below the horizontal centerline. Passageways and bosses provide for oil and air transfer and various accessories. Provision for installing a vibration sensing device is incorporated at approximately the 12 o'clock position at the front flange.



C11484A

Intermediate Case Assembly
Figure 1

INTERMEDIATE CASE ASSEMBLY - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance procedures for the intermediate case assembly.

2. Consumable Materials

   Not Applicable

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Approved Repairs (Ref. Fig. 201)

   In most cases, damage to female threads in engine mount pads can be repaired by replacing the damaged insert with a new insert of the same size.

   A. Engine Mount Pads - Threaded Inserts

      (1) Drill out insert material between locking keys to depth of 3/16 inch, using a 17/32 inch diameter drill (refer to Detail A).

      (2) Bend keys inward as in Detail B, using suitable punch, and break off.

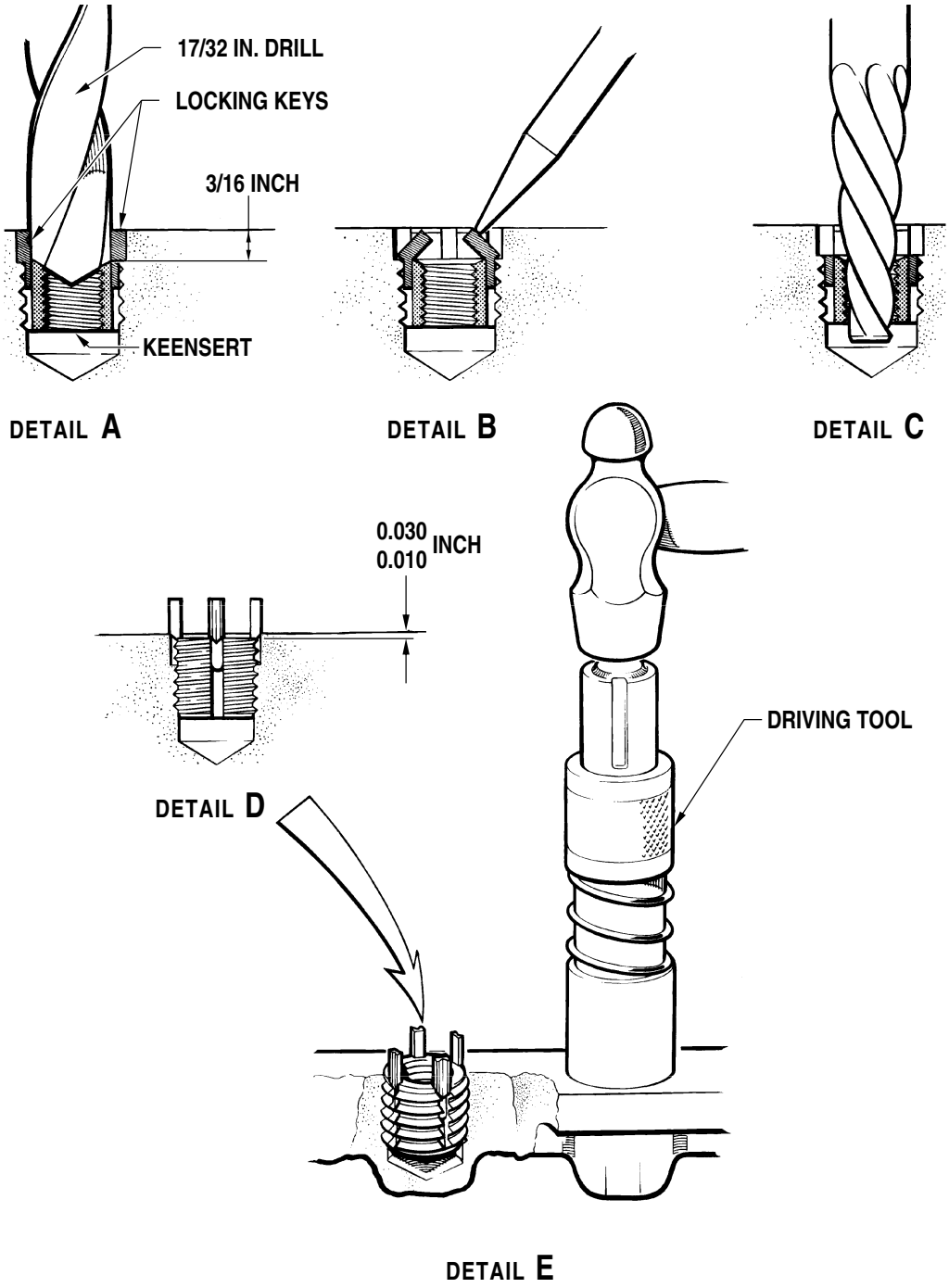
      (3) Remove insert with E-Z OUT or similar extractor.

      (4) Screw in replacement insert with fingers until it lies 0.010 inch to 0.030 inch below surface (refer to Detail D).

      (5) Drive keys down with several light taps on key driving tool or suitable equivalent (refer to Detail E).

   B. Corrosion

      (1) Treat corrosion on intermediate case in accordance with Chapter 70-00-00, REPAIR, Corrosion Treatment - Magnesium Alloy Components.



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Approved Repairs
Figure 201

LP COMPRESSOR ROTOR ASSEMBLIES- DESCRIPTION AND OPERATION

1. Description (Ref. Fig. 1)

   A. LP Compressor Rotor Assemblies

      The LP compressor case houses the two stages of the LP compressor rotor assembly. The first-stage (fan) is an internally splined titanium rotor which is followed by a second stage, keyed titanium boost stage rotor. Air for the engine core is driven rearward by the fan, compressed by the booster rotor and directed through a set of vanes toward the HP compressor.

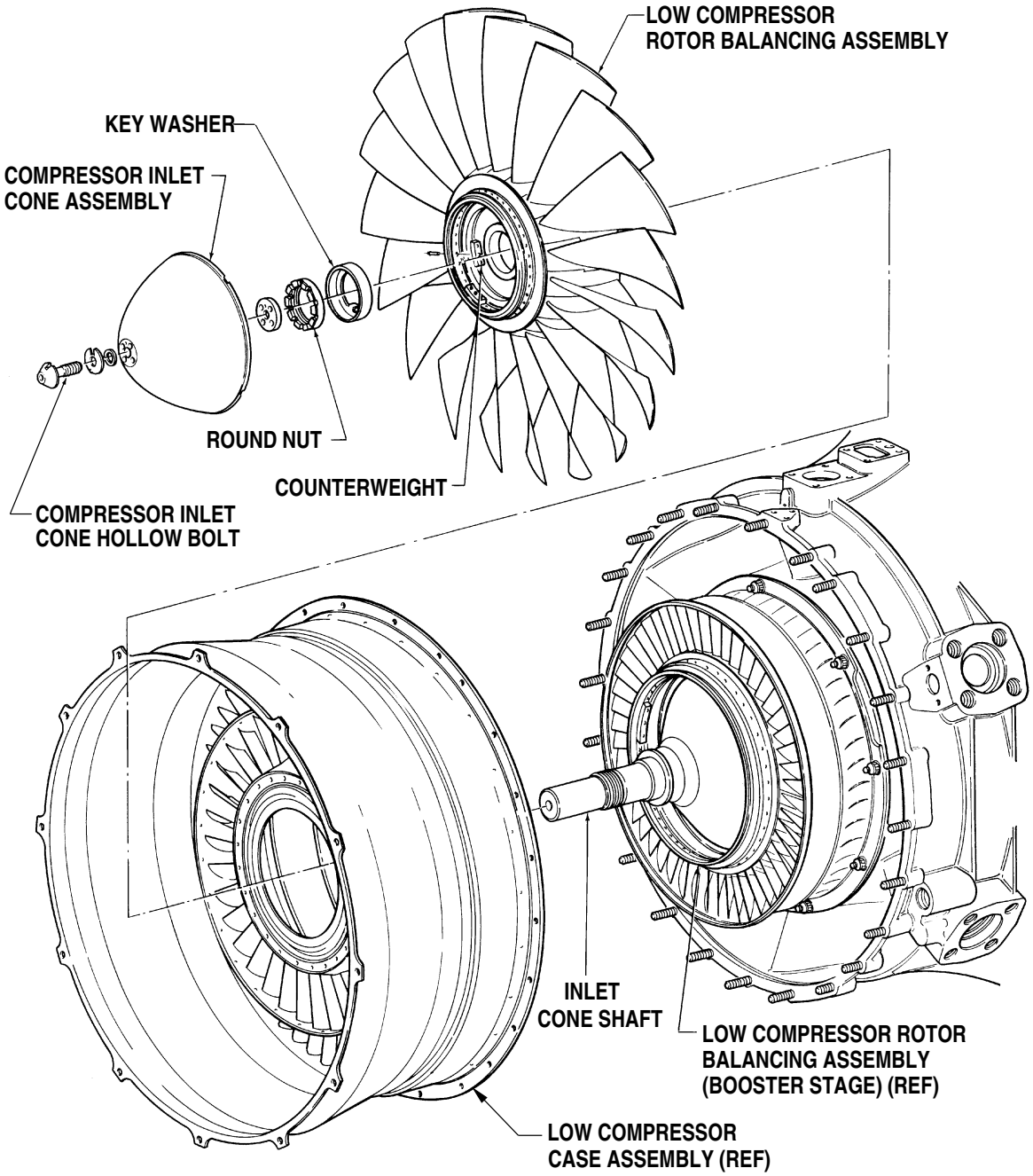
      The first stage disk holds 19 titanium blades with the blade roots radially dovetailed into slots in the disk. Two L-shaped blade retaining rings, riveted to the disk front and rear balance rims respectively, secure the blades axially. The fan is detail-balanced in two planes using counterweights riveted to the inner surfaces of the balance rims. The fan is mounted on the splined front end of the LP compressor shaft and is secured to the shaft with a keyed cupwasher and round nut.

      The booster stage rotor, incorporating 50 short blades, is installed on the LP compressor shaft behind the fan from which it is separated by a spacer. The blade roots are radially dovetailed into slots in the disk and secured axially by two titanium retaining rings riveted to the disk balance rims. The front retaining ring incorporates a labyrinth air seal. The booster-stage rotor is detail- balanced in two planes by means of riveted counterweights.Procedures for removing the booster stage rotor are not included in this manual.

      In addition to detail balancing, the complete LP compressor rotor assembly, comprising inlet cone, fan, booster stage rotor and shafts, is trim balanced at assembly in two planes by addition of counterweights to both disks.

   B. Compressor Inlet Cone

      The compressor inlet cone is a double-skinned sheet metal assembly which is installed with a tight fit over the LP compressor forward blade retaining ring. A hollow bolt secures the inlet cone and its spacer to the inlet cone shaft, an extension of the LP compressor shaft. The booster-stage rotor is detail-balanced in two planes by removing material from the inner cone assembly at its rear flange and intermediate flange members.The inlet cone shaft is secured in the LP compressor shaft by two straight headless pins.



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LP Compressor Rotor Balancing Assembly and Inlet Cone Assembly
Figure 1

LP COMPRESSOR ROTOR - MAINTENANCE PRACTICES

1. General

A. The following are the maintenance practices for the LP compressor rotor and inlet cone assemblies.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC05-018	Metal Marking Crayon
PWC05-070	Pressure Sensitive Tape
PWC06-004	Anti-seize Compound (Paste)
PWC11-010D	Methyl Alcohol
PWC11-014	Isopropyl Alcohol

3. Special Tools

The special tools listed below are used in the following procedures.

Tool No.	Name	Application
PWC30304-11	Rivet Set, LP Compressor Trim Balance Weight Rivets	
PWC30304-12	Rivet Set, LP Compressor Trim Balance Weight Rivets	
PWC31036	Socket, Inlet Cone Bolt	
PWC31047	Sleeve, LP Compressor Removal	
PWC31050	Torque Wrench	JT15D-5 (Pre-SB7318)
PWC31400	Adapter, LP Compressor Removal/Installation	JT15D-5 (Pre-SB7318)
PWC31461	OBSOLETE	Replaced by PWC52094
PWC31515	Extension Bar, LP Compressor Removal/Installation	JT15D-5 (Pre-SB7318)
PWC31587	Riveter, LP Compressor Trim Balance Weight Rivets	

Tool No.	Name	Application
PWC31632	Puller, LP Compressor Removal/Installation	
PWC31638	OBSOLETE	Replaced by PWC52079
PWC31690	Puller, Inlet Cone	
PWC32506	DELETED	Replaced by PWC89837
PWC32507	Hydraulic Pump	
PWC32550	Wrench Adapter	JT15D-5 (Post-SB7318) and JT15D-5R
PWC41050	Torque Wrench	JT15D-5 (Post-SB7318) and JT15D-5R
PWC52076	Socket, LP Compressor Removal/Installation	JT15D-5 (Post-SB7318) and JT15D-5R
PWC52077	Adapter, LP Compressor Removal/Installation	JT15D-5 (Post-SB7318) and JT15D-5R
PWC52079	Crimper, LP Compressor Cupwasher	JT15D-5 (Pre-SB7436) (Replaces PWC31638)
PWC52080	Support, LP Compressor Removal/Installation	
PWC52092	Velocity Sensor Adapter	
PWC52094	Socket, LP Compressor Removal/Installation	JT15D-5 (Pre-SB7318) (Replaces PWC31461)
PWC52366	Crimper, LP Compressor Cupwasher	JT15D-5 (Post-SB7436) and JT15D-5R
PWC52445	Wrench, Assembly, Compressor Inlet Cone	
PWC52594	Pad	
PWC52595	Pusher	
PWC89837	Hydraulic Cylinder	Replaces PWC32506

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Removal/Installation (Heavy Maintenance Only)

A. Removal of Inlet Cone Assembly (Ref. Fig. 201)

CAUTION: HANDLE INLET CONE, WHICH IS A BALANCED ASSEMBLY, WITH CARE.

(1) Unstake keywasher (2) and remove inlet cone retaining bolt (1) using socket (PWC31036). Remove keywasher (2) and washer (3). Discard keywasher.

(2) Remove threaded knurled screw from housing on puller (PWC31690) and install in inlet cone threaded hole, vacated by retaining bolt (1). Tighten threaded knurled screw to establish a ¼ inch gap between knurled head of screw and inlet cone assembly (4).

CAUTION: EXERCISE CARE WHEN USING PULLER TO AVOID DAMAGE TO LP COMPRESSOR BLADES.

(3) Install main body of puller and engage the three puller fingers with the three slots on the rear flange of the inlet cone (4).

(4) Tighten the three knurled adjustment screws on the puller hand tight.

(5) Align large threaded center screw with hexagonal head with the center of the threaded knurled screw installed in the inlet cone (4).

(6) Apply a lubricant in 90° groove in head of previously-installed threaded knurled screw.

NOTE: The purpose of the lubricant is to reduce friction as the spherical tip of larger screw rotates within 90° groove of the threaded knurled screw.

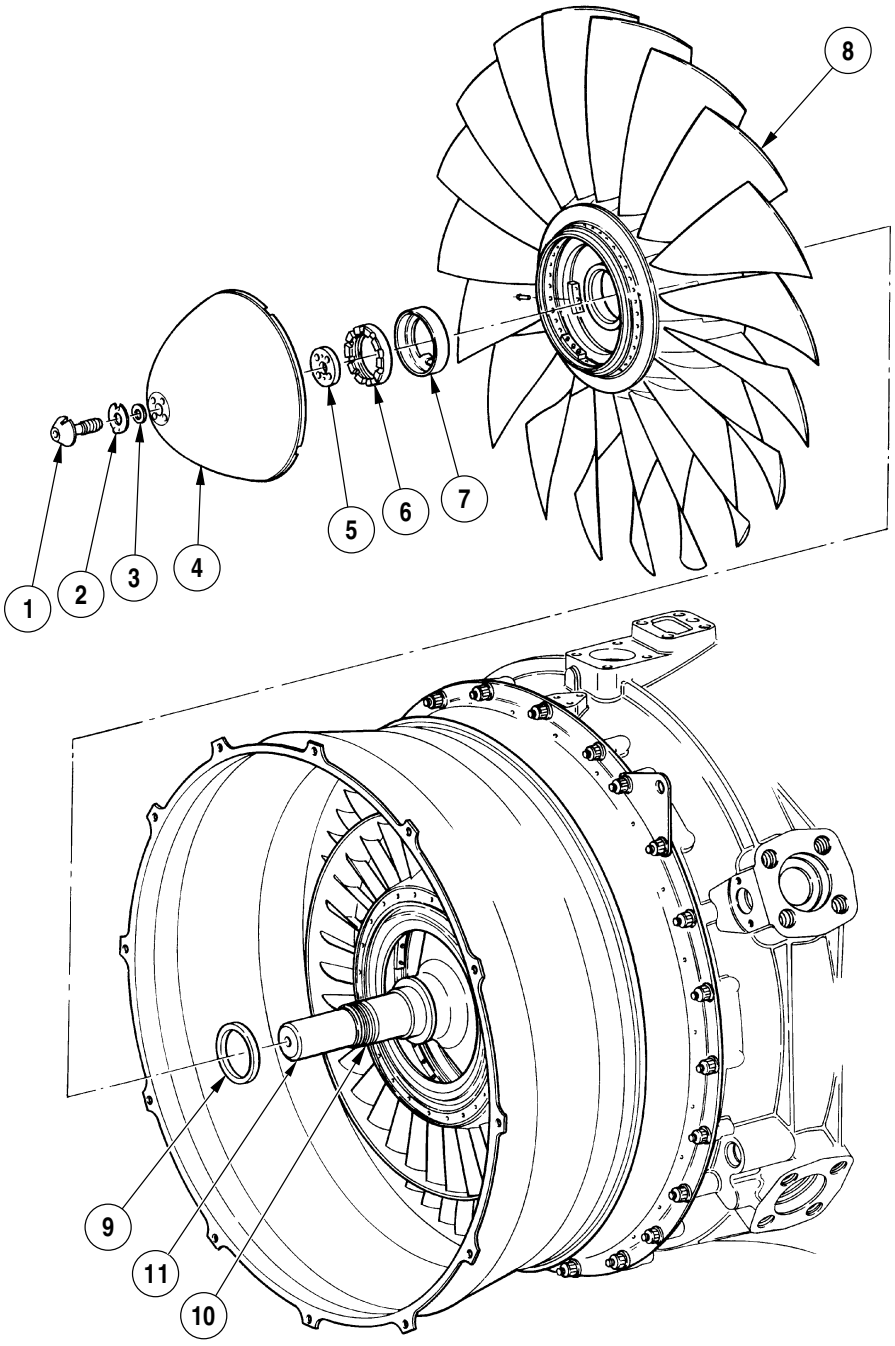
CAUTION: DO NOT FORCE THE HEXAGONAL-HEADED CENTER SCREW IF THE INLET CONE CONTACTS THE THREADED KNURLED SCREW INSTALLED IN THE INLET CONE SHAFT.

(7) Retain smaller threaded knurled screw and tighten large hexagonal-headed center screw to remove inlet cone.

NOTE: If the front face of the inlet cone contacts the threaded knurled screw before the inlet cone is free from LP compressor hub, loosen the knurled screw one turn, then continue to tighten the hexagonal-headed center screw

(8) Remove puller assembly (PWC31690) from inlet cone, and remove threaded knurled screw from the inlet cone. Reinstall knurled screw on puller body.

(9) Remove compressor inlet cone assembly (4).



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Removal/Installation - LP Compressor Rotor Balancing Assembly and Inlet Cone Assembly
Figure 201

Key to Figure 201

1. Bolt
2. Keywasher
3. Flat Washer
4. Inlet Cone Assembly
5. Spacer
6. Retaining Nut
7. Cupwasher
9. Spacer
10. LP Compressor Shaft
11. Inlet Cone Shaft

(10) Remove inlet cone spacer (5).

NOTE: 1. Spacer (5) will normally remain in inlet cone (4).

NOTE: 2. The inlet cone adjusting spacer is matched to LP compressor adjusting spacer.

B. Installation of Inlet Cone Assembly (Ref. Fig. 201)

(1) Install spacer (5) in inlet cone assembly (4).

NOTE: Observe inlet cone spacer thickness dimension requirement (Ref. Subpara. 5.D.).

(2) Heat inner spigot diameters of inlet cone (4) with a suitable heat gun for 15 minutes.

(3) Align inner cone pin and cone and inlet cone shaft index marks. Install inlet cone assembly (4) onto inlet cone shaft (11).

(4) Install wrench (PWC52445) and tighten to 140 lb.in. Allow inlet cone to cool to ambient temperature with wrench installed. Remove wrench.

(5) Lubricate threads and thrust face of bolt (1) with anti-seize compound (PWC06-004). Position flat washer (3) and keywasher (2) on bolt.

(6) Secure inlet cone assembly (4) to inlet cone shaft (11) with bolt (1). Tighten and torque bolt (REF. NO. 1707, Table 205) using socket (PWC31036), then lock keywasher.

NOTE: The inet cone assembly bolt is used to engage the snap diameter of the cone to the LP compressor hub.

C. Removal of LP Compressor Rotor (Ref. Fig. 201)

(1) Remove inlet cone assembly (Ref. Para. 5.A.).

(2) Unstake cupwasher (7) using suitable alloy drift.

(3) JT15D-5 (Pre-SB7318) engines:

(a) Install socket (PWC52094) and extension bar (PWC31515) on LP compressor shaft (10). Install adapter (PWC31400) on wrench (PWC31050), then install wrench and adapter over socket.

CAUTION: OPERATE WRENCH TO ROTATE LP COMPRESSOR CLOCKWISE AS VIEWED FROM FRONT OF ENGINE.

(b) Loosen retaining nut (6) using wrench (PWC31050).

NOTE: Socket holds nut stationary as wrench drives adapter to rotate LP compressor rotor.

(4) JT15D-5 (Post-SB7318) and JT15D-5R engines:

(a) Install support bridge (PWC52080) with barrel to rear on front flange of LP compressor case. Secure to flange with three 0.250-28 inch bolts.

(b) Install socket (PWC52076) through center of bridge support ensuring socket engages in LP compressor shaft and shaft nut. Using 0.25 inch Allen wrench, tighten socket internal bolt handtight to secure. Install adapter (PWC52077) in socket (PWC52076).

(c) Ensure wrench adapter (PWC32550) is secured to back of wrench (PWC41050). Install wrench over adapter (PWC52077) and socket (PWC52076).

(d) Loosen retaining nut (6) using wrench (PWC41050).

(5) Remove previously installed special tooling, retaining nut (6) and cupwasher (7). Discard cupwasher.

(6) Prior to removal of LP compressor rotor assembly, check that shaft and LP compressor rotor are indexed. If not, use a metal marking crayon (PWC05-018) to mark position of low pressure compressor hub relative to shaft for reference at assembly. Confirm position of trim balance weights relative to data plate (Ref. Para. 5.E.).

CAUTION: TITANIUM ALLOY PART: HANDLE WITH EXTREME CARE WEARING CLEAN, LINT-FREE GLOVES. DO NOT SCRATCH OR CAUSE NICKS OR ABRASIONS.

(7) Install puller (PWC31632) and sleeve (PWC31047) and carefully remove LP compressor rotor assembly (8).

(8) Store rotor in a suitable protective container.

(9) If LP compressor rotor assembly is to be shipped for repair, or if a new LP compressor rotor assembly is to be ordered:

(a) Record class and position of all trim balance weights, if any. Record orientation of any asymetric trim balance weight.

(b) Supply this information to appropriate facility for correct trim balance weight installation and to prevent detail balance weights being installed at trim balance weight locations.

D. Installation of LP Compressor Rotor (Ref. Fig. 201)

CAUTION: THE LP COMPRESSOR IS A TITANIUM ALLOY PART: HANDLE WITH EXTREME CARE WEARING CLEAN, LINT-FREE GLOVES. DO NOT SCRATCH OR CAUSE NICKS OR ABRASIONS.

(1) If a replacement, serviced or repaired LP compressor rotor is to be installed, refer to subparagraph 5.E.

(2) Heat LP compressor rotor (8) internal shaft seating diameters for 5 minutes using a suitable heat gun.

(3) If a replacement LP compressor rotor (8) is to be installed, it is recommended that the existing spacer (9) be replaced. If replaced, measure and record actual thickness of new spacer.

(4) If existing LP compressor rotor (8) is to be installed, use existing spacer (9). Measure and record actual spacer thickness.

(5) Post-SB7324 engines: If new or existing spacer is more than 0.4000 in. thick, grind spacer to 0.3950 to 0.4000 in. thick and record actual thickness after grinding. Faces of spacer must be flat and parellel within 0.0002 inch after grinding.

NOTE: Spacer thickness limit is to make sure sufficient LP compressor shaft thread is available for torquing fan locking nut.

(6) Install spacer on LP compressor shaft (10) with V-mark aligned with shaft V-mark.

CAUTION: THE LP COMPRESSOR IS A TITANIUM ALLOY PART: HANDLE WITH EXTREME CARE WEARING CLEAN, LINT-FREE GLOVES. DO NOT SCRATCH OR CAUSE NICKS OR ABRASIONS.

CAUTION: THE LP COMPRESSOR SHOULD BE SEATED BY HAND. THE ROTOR MUST FREELY ENTER FINAL SEATING POSITION PRIOR TO INSTALLING CUPWASHER AND NUT. IF RESISTANCE IS FELT, REMOVE, REHEAT AND RE-INSTALL ROTOR.

(7) Remove LP compressor rotor (8) from source of heat and install on LP compressor shaft (10). Align index marks or pencil marks made on removal.

(8) Select step (9) or step (10) fan installation methods.

NOTE: The LP compressor may be installed with or without the use of hydraulic pre-loading equipment.

(9) **Install the LP compressor (8) as follows if no optional hydraulic tools are to be used during installation procedure**:

(a) Install slave cupwasher (7).

(b) Lubricate threads and thrust face of retaining nut (6) with a thin, even film of anti-seize compound (PWC06-004).

(c) Install retaining nut (6) and tighten with your hand enough to make slight contact with the cupwasher (7).

(d) Install wrench and tool set on JT15D-5 (Pre-SB7318) engines as follows:

1 Install socket (PWC52094) and extension bar (PWC31515) on LP compressor shaft (10). Install adapter (PWC31400) on wrench (PWC31050), then install wrench and adapter over socket.

(e) Install wrench and tool set on JT15D-5 (Post-SB7318) or JT15D-5R engines as follows:

1 Install support bridge (PWC52080) with barrel to rear on front flange of LP compressor case. Secure to flange with three 0.250-28 inch bolts.

2 Install socket (PWC52076) through center of bridge support ensuring socket engages in low pressure compressor shaft and shaft nut. Using 0.25 inch Allen wrench, tighten socket internal bolt handtight to secure. Install adapter (PWC52077) in socket (PWC52076).

3 Make sure wrench adapter (PWC32550) is secured to back of wrench (PWC41050). Install wrench over adapter (PWC52077) and socket (PWC52076).

CAUTION: OPERATE (PWC31050) WRENCH TO ROTATE LP COMPRESSOR ROTOR COUNTERCLOCKWISE AS VIEWED FROM FRONT OF ENGINE.

(f) Refer to Fits and Clearances, Table 205, REF. NO. 1723. Operate wrench (PWC31050) or (PWC41050) and perform the first torque operation while the fan is still hot. Keep the tools installed and do not loosen the nut at this time.

NOTE: 1. If replacement LP compressor rotor was installed with existing spacer (9), torque fan locking nut gradually. Tighten nut slowly to ensure existing spacer prevents rotor blades contacting LP compressor case.

NOTE: 2. When the specified torque is reached, the reading may drop rapidly at first. Reapply torque until reading has stabilized for one minute.

(g) Remove wrench and tool set after rotor assembly has cooled to ambient temperature.

(h) Check LP compressor blade tip clearance as follows:

1 Determine longest blade by checking for minimum leading edge tip clearance in 6 o'clock position, using feeler gage.

2 Using feeler gages, measure and record tip clearance between longest blade and inlet case at 6 o'clock position.

NOTE: 1. When taking tip clearance, LP compressor rotor should be loaded forward, by manually pulling on LP compressor shaft extension, to take up No.1 bearing end float. Pull longest blade forward with minimum force to take up axial play of blade.

NOTE: 2. Ensure that feeler gages are placed parallel to inlet case conical surface during clearance measurement.

3 Turn LP compressor rotor through 90 degrees and again measure and record longest blade tip clearance. Repeat at successive intervals of 90 degrees to have measured tip clearance at four equally spaced positions around circumference. Compare measured tip clearance values to required tip clearance limit (REF. NO. 1022, Table 204).

4 If measured tip clearance is not within limits (REF. NO. 1022, Table 204), remove LP compressor rotor and LP compressor spacer (9). Grind LP compressor spacer (9) to obtain required clearance. Record final spacer thickness. Repeat initial retaining nut (6) torque procedures, preceding.

NOTE: Reducing spacer (9) thickness 0.0065 inch will reduce tip clearance 0.001 inch. New or existing nose cone spacer (5) must be ground to same thickness as spacer (9) within 0.001 inch.

(i) If fan blade tip clearance is within limits, reinstall appropriate torque wrench and tool set per steps (d) or (e). Operate wrench and loosen retaining nut to zero torque (Ref. Subpara. 5.C.). Remove wrench and tool set, then remove LP compressor retaining nut (6) and slave cupwasher (7). Discard the slave cupwasher.

(j) Clean LP compressor retaining nut (6) of anti-seize compound that was applied during first tightening procedure.

(k) Install a new cupwasher (7) on the LPC shaft.

(l) Lubricate threads and thrust face of retaining nut (6) with a thin, even film of anti-seize compound (PWC06-004).

(m) Install retaining nut (6) and tighten with your hand enough to make slight contact with the cupwasher (7).

(n) Using a metal marking crayon (PWC05-018), draw a continuous axial line along the surface of cupwasher (7) and adjacent to LP compressor hub.

(o) Install appropriate torque wrench and tool set per steps (d) or (e).

(p) Refer to Fits and Clearances, Table 205, REF. NO. 1723. Operate wrench and perform final torque procedure.

(q) Remove wrench and tool set.

(r) Proceed to step (11).

(10) **Install the LP compressor (8) as follows when optional hydraulic tools are to be used during installation procedure**:

(a) Install optional hydraulic tool set and apply a load to pre-heated LP compressor as follows:

1 Remove and retain nut from pad of shaft pusher (PWC52595), and install shaft pusher (PWC52595) on the LP compressor shaft (10). Install fan pad booster (PWC52594) over shaft pusher (PWC52595). Install cylinder (PWC89837) on shaft of pusher (PWC52595) and install previously removed nut to attach cylinder to the pusher.

2 Connect pump (PWC32507) to cylinder (PWC89837) and operate pump to apply load to fan assembly per procedure in Table 207, REF. NO. 1928.

3 Maintain load until parts cool to ambient temperature.

4 Remove the hydraulic pre-loading tools.

(b) Check LP compressor blade tip clearance as follows:

1 Determine longest blade by checking for minimum leading edge tip clearance in 6 o'clock position, using feeler gage.

2 Using feeler gages, measure and record tip clearance between longest blade and inlet case at 6 o'clock position.

NOTE: 1. When taking tip clearance, LP compressor rotor should be loaded forward, by manually pulling on LP compressor shaft extension, to take up No.1 bearing end float. Pull longest blade forward with minimum force to take up axial play of blade.

NOTE: 2. Ensure that feeler gages are placed parallel to inlet case conical surface during clearance measurement.

3 Turn LP compressor rotor through 90 degrees and again measure and record longest blade tip clearance. Repeat at successive intervals of 90 degrees to have measured tip clearance at four equally spaced positions around circumference. Compare measured tip clearance values to required tip clearance limit (REF. NO. 1022, Table 204).

4 If measured tip clearance is not within limits (REF. NO. 1022, Table 204), remove LP compressor rotor and LP compressor spacer (9). Grind LP compressor spacer (9) to obtain required clearance. Record final spacer thickness. Repeat initial retaining nut (6) torque procedures, preceding.

NOTE: Reducing spacer (9) thickness 0.0065 inch will reduce tip clearance 0.001 inch. New or existing nose cone spacer (5) must be ground to same thickness as spacer (9) within 0.001 inch.

(c) If fan blade tip clearance is within limits, install a slave cupwasher (7).

(d) Lubricate threads and thrust face of retaining nut (6) with a thin, even film of anti-seize compound (PWC06-004).

(e) Install retaining nut (6) and tighten with your hand enough to make slight contact with slave cupwasher (7).

(f) Install wrench and tool set on JT15D-5 (Pre-SB7318) engines as follows:

1 Install socket (PWC52094) and extension bar (PWC31515) on LP compressor shaft (10). Install adapter (PWC31400) on wrench (PWC31050), then install wrench and adapter over socket.

(g) Install wrench and tool set on JT15D-5 (Post-SB7318) or JT15D-5R engines as follows:

1 Install support bridge (PWC52080) with barrel to rear on front flange of LP compressor case. Secure to flange with three 0.250-28 inch bolts.

2 Install socket (PWC52076) through center of bridge support ensuring socket engages in low pressure compressor shaft and shaft nut. Using 0.25 inch Allen wrench, tighten socket internal bolt handtight to secure. Install adapter (PWC52077) in socket (PWC52076).

3 Make sure wrench adapter (PWC32550) is secured to back of wrench (PWC41050). Install wrench over adapter (PWC52077) and socket (PWC52076).

CAUTION: OPERATE (PWC31050) WRENCH TO ROTATE LP COMPRESSOR ROTOR COUNTERCLOCKWISE AS VIEWED FROM FRONT OF ENGINE.

(h) Refer to Fits and Clearances, Table 205, REF. NO. 1723. Operate wrench and perform the first torque procedure.

NOTE: 1. If replacement LP compressor rotor was installed with existing spacer (9), torque fan locking nut gradually. Tighten nut slowly to ensure existing spacer prevents rotor blades contacting LP compressor case.

NOTE: 2. When the specified torque is reached, the reading may drop rapidly at first. Reapply torque until reading has stabilized for one minute.

(i) Loosen nut to zero torque (Ref. Subpara. 5.C.), then remove the wrench and tool set.

(j) Remove nut (7) and slave cupwasher (6). Discard the slave cupwasher.

(k) Clean LP compressor retaining nut (6) of anti-seize compound that was applied during first tightening procedure.

(l) Install a new cupwasher (7) on the LPC shaft.

(m) Lubricate threads and thrust face of retaining nut (6) with a thin, even film of anti-seize compound (PWC06-004).

(n) Install retaining nut (6) and tighten with your hand enough to make slight contact with the cupwasher (7).

(o) Using a metal marking crayon (PWC05-018), draw a continuous axial line along the surface of cupwasher (7) and adjacent to LP compressor hub.

(p) Install appropriate torque wrench and tool set per steps (f) or (g).

(q) Refer to Fits and Clearances, Table 205, REF. NO. 1723. Operate wrench and perform final torque procedure.

(r) Remove wrench and tool set.

(s) Proceed to step (11).

CAUTION: IF CUPWASHER ROTATION, INDICATED BY PENCIL LINE, IN EXCESS OF 0.030 INCH HAS OCCURRED, REPLACE CUPWASHER AND REPEAT FINAL TORQUING PROCEDURE.

(11) Check continuity of pencil line. Do not lock cupwasher (7) at this time.

(12) If measured tip clearance is within limits (REF. NO. 1022, Table 204) and cupwasher (7) is correctly aligned, lock cupwasher using crimper (PWC52079) for JT15D-5 (Pre-SB7436) engines, or crimper (PWC52366) for JT15D-5 (Post-SB7436) or JT15D-5R engines.

(13) Inlet cone spacer (5) must have same thickness as LP compressor spacer (9) within 0.001 inch (Ref. step (h)).

(14) Install inlet cone assembly (Ref. Subpara. 5.A.).

(15) If a replacement or repaired LP compressor rotor was installed, perform required ground checks (Ref. 71-00-00, ADJUSTMENT/TEST,).

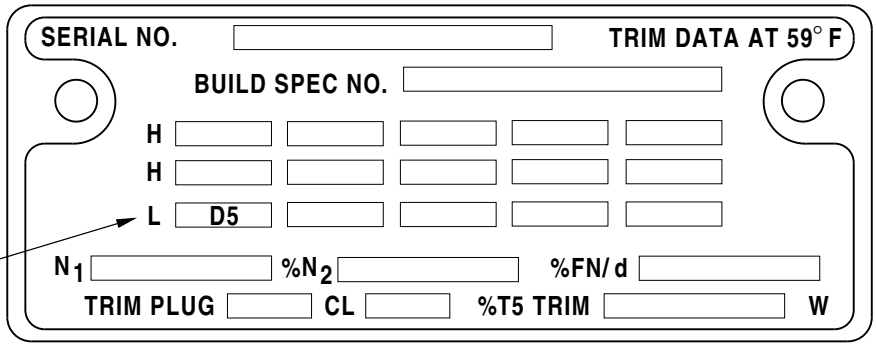
(16) To optimise engine vibration levels following replacement of the fan, an on-aircraft engine vibration analysis and possible fan trim balance operation is recommended at the earliest convenient opportunity, but is not mandatory (Ref. 71-00-00, ADJUSTMENT/TEST, On-Aircraft Engine Vibration Analysis and Fan Trim Balance).

E. Installation and Balance Weight Coding for Replacement, Serviced or Repaired LP Compressor Rotor (Ref. Fig. 202)

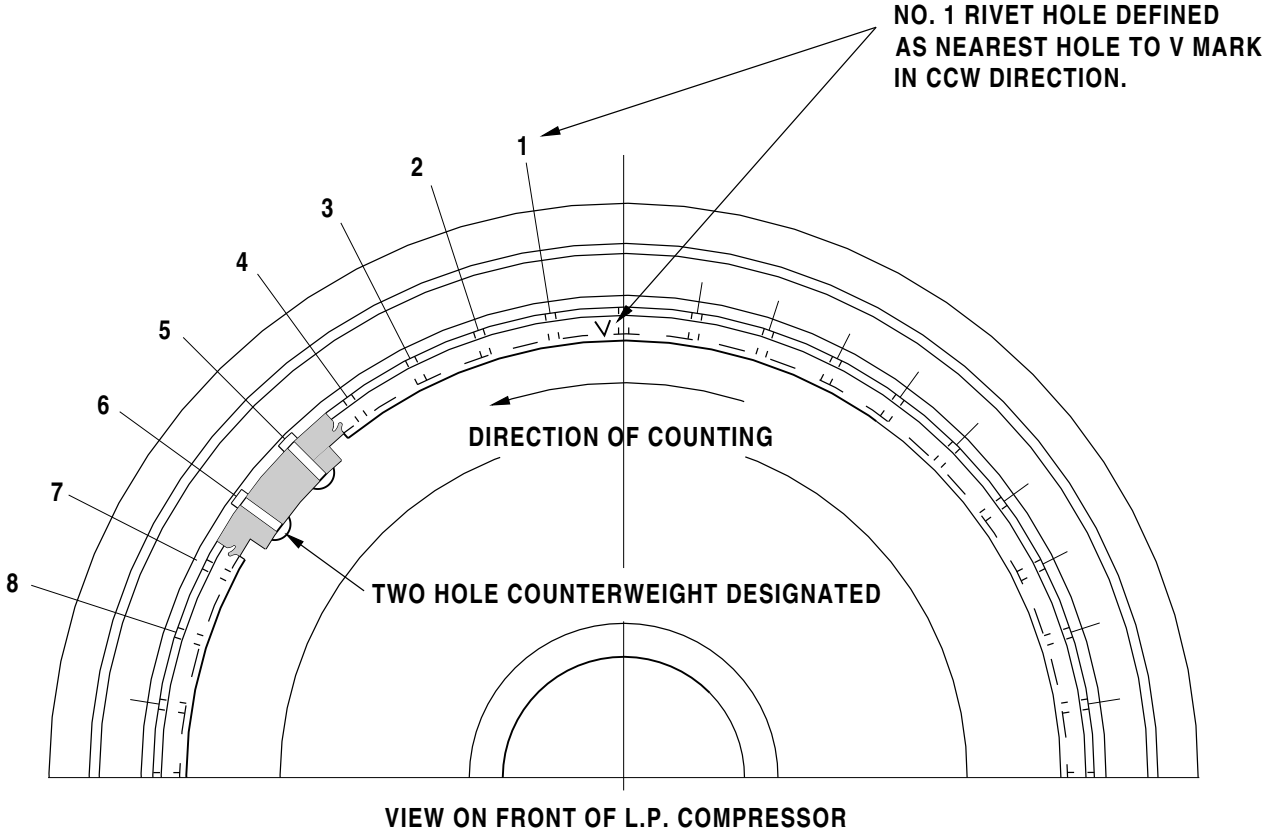
(1) To meet engine balance requirements, a repaired or replacement fan must be installed with correct engine trim balance weight configuration. Use the following procedure for repaired or replacement rotor which has been detail-balanced, but which has not had trim balance weights installed at required locations.

IDENTIFY COUNTERWEIGHTS
AS FOLLOWS:
CLASS 1 = A (1 HOLE)
CLASS 2 = B (1 HOLE)
CLASS 3 = C (1 HOLE)
CLASS 4 = D (2 HOLES)
CLASS 5 = E (3 HOLES)

DEFINITION:
L = LOW COMPRESSOR TRIM BALANCE
D = COUNTERWEIGHT CLASS
5 = FIRST HOLE OCCUPIED
BY COUNTERWEIGHT



TRIM DATA PLATE
(MOUNTED ON ACCESSORY GEARBOX)



VIEW ON FRONT OF L.P. COMPRESSOR

C31808

LP Compressor Rotor Trim Balance Coding - Front Rim Application
Figure 202

(2) Refer to engine trim data plate on accessory gearbox and engine log book for existing trim balance counterweight class and location. If trim data plate (Ref. 71-00-00, ADJUSTMENT/TEST, Test Information) or engine log book read NR (Not Required), no engine trim balance adjustments are necessary . Install replacement fan as received (Ref. Subpara. 5.C.).

(3) Refer to Figure 202 and Table 201 for trim balance class and location code definition.

TABLE 201, Trim Balance Counterweight and Rivet Classes

Counterweight Class	Counterweight Letter Code	No. of Rivet Holes	Weight (ounce)
1	A	1	0.065
2	B	1	0.106
3	C	1	0.147
4	D	2	0.299
5	E	3	0.452

(4) Check that no detail balance counterweights are installed at trim balance counterweights locations on replacement or repaired fan. If detail balance weights are installed at trim balance counterweight locations, return fan to service facility for additional balancing and relocation of detail balance counterweights.

(5) If required, remove rivets securing counterweights to front balance rim or rejected fan using a flat chisel and a suitable diameter punch. Note orientation of any asymmetric trim balance weights for correct relocation on replacement fan.

(6) Install trim balance counterweights removed from rejected fan on replacement fan balance rim locations as defined by trim data plate or log book. Insert rivets from inside diameter of fan balance rim. Upset rivets using riveter (PWC31587)and rivet sets (PWC30304-11) and (PWC30304-12).

(7) Install LP compressor rotor (Ref. Subpara. 5. C.).

6. Adjustment/Test

A. On-Wing Engine Vibration Analysis and Trim Balance

Relocated to 71-00-00, ADJUSTMENT/TEST

7. Inspection/Check

A. Inspection of Inlet Cone

(1) Inspect inlet cone for foreign object damage and erosion.

(2) Inspect cone for signs of cracks. Cracks are not acceptable.

(3) Inspect cone for dents. A maximum of three dents is permitted, provided depth of each dent is not more than 0.060 inch and does not measure more than 1.0 inch across. Dents directly adjoining each other are not acceptable.

(4) At assembly, check cone for security of attachment.

B. LP Compressor Booster Stage Rotor Blade Inspection

NOTE: The LP compressor booster rotor may only be removed at an approved overhaul facility.

(1) Inspect the booster stage rotor blades when foreign object damage (FOD) has ocurred, when it is suspected the FOD has occurred, or whenever the HP compressor is inspected. (Ref. 72-00-00, INSPECTION).

(2) Inspect booster rotor blades in accordance with Table 202 and Figure 203.

TABLE 202, LP Compressor Booster Rotor Blade - Inspection

LOCATION	MAXIMUM ALLOWABLE	CORRECTIVE ACTION
Area b	Nicks, dents on leading edge up to 0.030 inch deep	Blend repair blade(s). Fluorescent-penetrant inspect blended area for cracks. If cracks are present or if damage is more than allowable limit, send engine to an approved overhaul facility for inspection and replacement of booster rotor.
Area c	No damage allowed	Send engine to an approved overhaul facility for inspection and repair.

C. Inspection of LP Compressor Rotor Blades

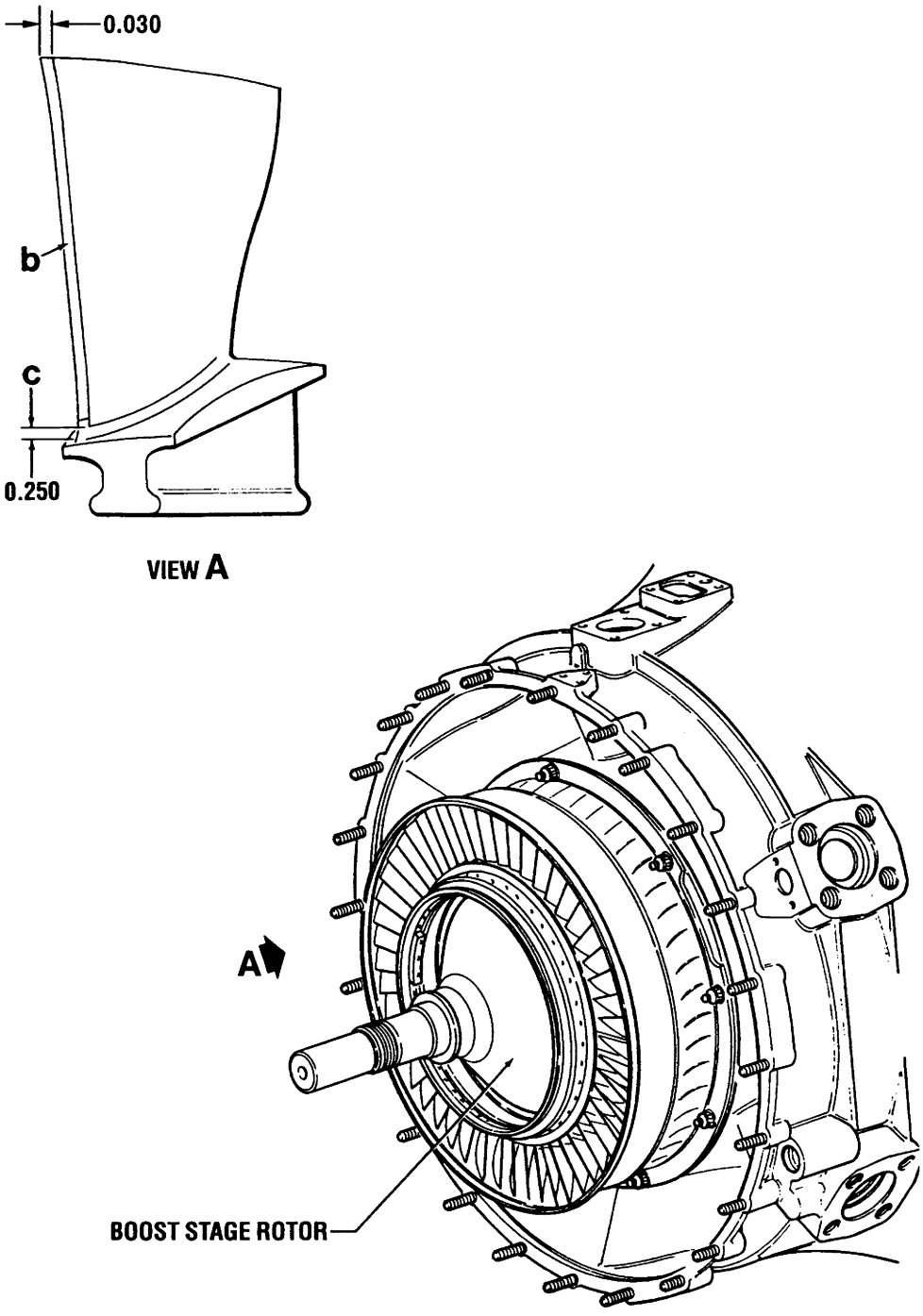
(1) Inspect LP compressor rotor blades (Ref. Table 203 and Fig. 204).

(2) If blade damage to LP compressor boost stage rotor is evident, return engine to an approved overhaul facility.

(3) A fan with blade damage beyond the blend repair limits in Table 203 must be removed from service and sent to an approved overhaul facility for repair. If an aircraft must be flown to a facility equipped for fan removal, record the extent of blade damage and submit this information to Pratt & Whitney Canada Inc. A review of the information may permit P&WC to recommend limited engine operation for purposes of obtaining a flight permit from the operator's regulatory authority.

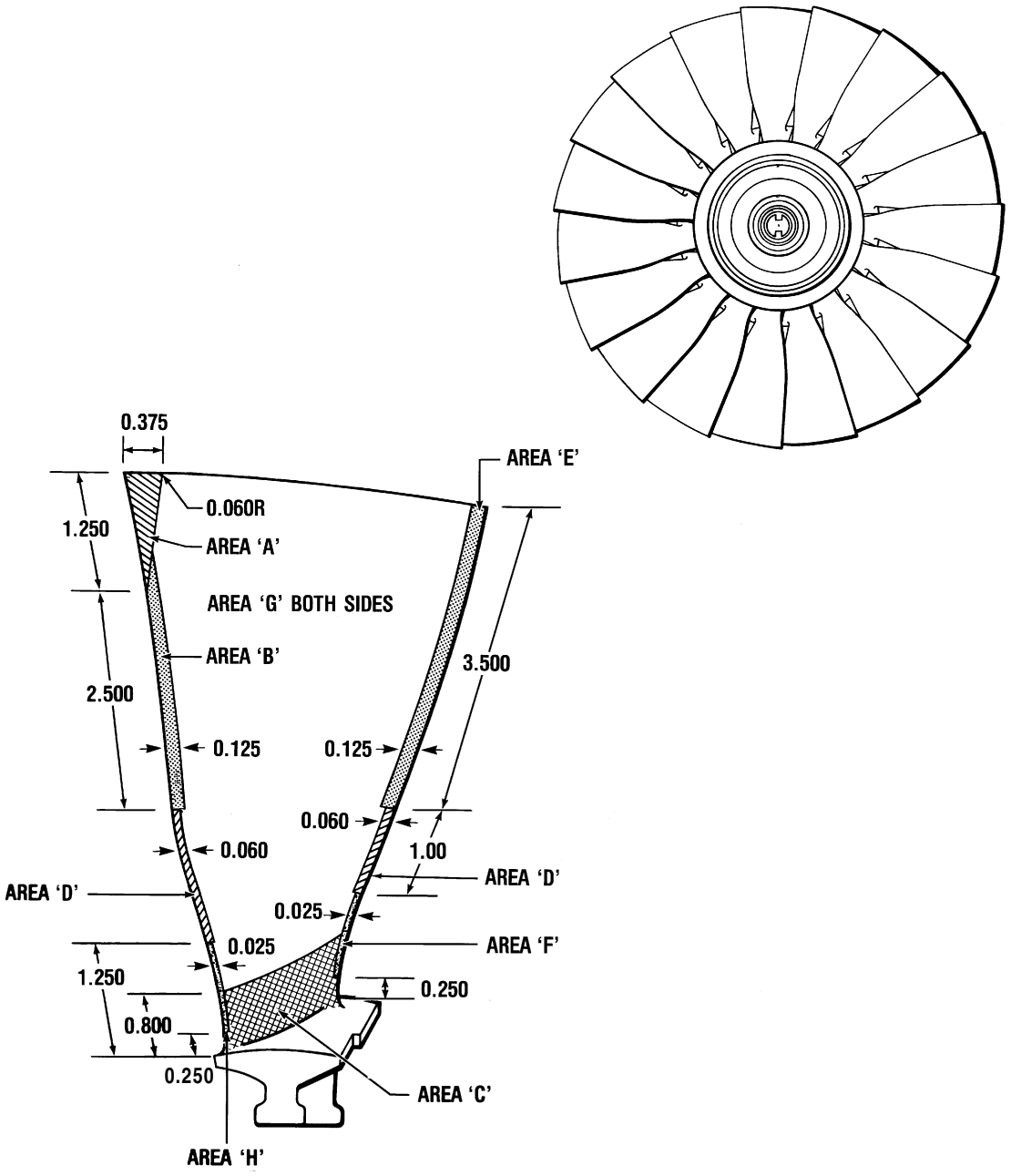
(4) Inspection of LP Compressor Rotor Blades

(a) Inspect LP compressor blades (Ref. Fig. 204 and Table 203).



C22754A

LP Compressor Booster Stage Rotor Blade Inspection - Heavy Maintenance
Figure 203



C11496B

LP Compressor Rotor Blade Inspection - Heavy Maintenance
Figure 204

(b) Repairs may be made up to a maximum of five blades, to the recommended limits, two of which may be consecutive, except in the case of Area A (Ref. Fig. 204) where two repairs are permitted, provided they are separated by a minimum of eight blades.

NOTE: Eight blade separation will minimize unbalance.

TABLE 203, LP Compressor Blade Inspection Limits

Blade Area	Damage Limits	Blend Radius Limits
A	Refer to Figure 204	Blend corners to 0.060 inch minimum radius.
B	0.060 inch dents (local blends) 0.010 inch deep face nicks 0.005 inch nicks each side 0.125 inch leading edge nicks	Blend surface to 0.250 inch minimum concave radius without reducing leading edge radii below 0.013 inch.
C	No damage permitted except for minor sand erosion (Ref. NOTE 7.)	Return assembly to approved overhaul facility.
D	0.060 inch dents (local blends) 0.010 inch deep face nicks or 0.005 inch nicks each side 0.060 inch leading edge nicks	Blend surface to 0.2500 inch minimum concave radius without reducing leading edge radii below 0.013 inch.
E	0.060 inch dents 0.005 inch deep face nicks or 0.0025 inch nicks each side 0.125 inch trailing edge nicks	Blend surface to 0.250 inch minimum concave radius without reducing trailing edge radii below 0.007 inch.
F	0.005 inch deep face nicks 0.025 inch trailing edge nicks No dents permitted	Blend surface to 0.250 inch minimum concave radius without reducing trailing edge below 0.010 inch.
G	0.015 inch depth at bottom or 0.0075 inch each side	Blend surface to 0.125 inch maximum concave radius.
H	0.025 inch dents 0.005 inch deep face nicks 0.025 inch leading edge nicks	Blend surface to 0.250 inch minimum concave radius without reducing leading edge radii below 0.013 inch.

NOTE: 1. The limits referred to in this table in areas B, D and E pertain to local isolated damage only and must not be interpreted as authority for removal all across the tip, leading or trailing edges as may be accomplished by a machine cut.

NOTE: 2. Blending must be to existing contour. Leading and trailing edge radii must be restored.

TABLE 203, LP Compressor Blade Inspection Limits (Cont'd)

Blade Area	Damage Limits	Blend Radius Limits
NOTE: 3. Areas B and D: multiple blended areas must not exceed a total of one inch on leading edge. On trailing edge one blend repair only permitted. Repaired areas to be inspected with portable fluorescent-penetrant equipment or dye check.		
NOTE: 4. Leading edge blends permitted if smooth and up to 0.060 inch maximum displacement.		
NOTE: 5. Erosion of the leading edge is acceptable without rework provided that repair limits are not exceeded.		
NOTE: 6. Assemblies exhibiting damage beyond the preceding blend limits must be returned to an approved overhaul facility for repair.		
NOTE: 7. Minor sand erosion, evidenced by rough leading edge (minute serrations) and multiple small shallow pits closely grouped, is acceptable to a maximum depth of 0.002 inch on Areas D, F, G and H, a maximum depth of 0.005 inch on areas A, B and E.		

8. Approved Repairs

A. LP Compressor Blades

(1) Repair LP compressor blades, provided damage does not exceed the Heavy Maintenance limits given in Paragraph 7.C.(4)(b), preceding.

(2) Mask sound blade surfaces adjoining damaged areas with pressure sensitive tape (PWC05-070) to prevent contamination.

WARNING: AN ACCUMULATION OF TITANIUM DUST IS A FIRE HAZARD. CLEAN UP TITANIUM DUST ON COMPLETION OF REPAIR AND DO NOT ALLOW DUST TO ACCUMULATE ON CLOTHING.

(3) Remove nicks, scratches or pits and sharp edges on blade by carefully blending with small hand files and stones. Finish blending with fine stones.

(4) Ensure that leading edge profile is maintained after repair.

(5) Remove masking tape and residue using isopropyl alcohol (PWC11-014).

(6) To measure and optimise engine vibration levels following blending repairs to LP compressor fan blades, an on-aircraft engine vibration analysis and possible fan trim balance operation at the earliest convenient opportunity is recommended, but is not mandatory (Ref. 71-00-00, ADJUSTMENT/TEST, On-Aircraft Engine Vibration Analysis and Fan Trim Balance).

9. Fits, Clearances and Torque Loadings

A. General

Refer to Tables 204 and 205, and Figure 205.

TABLE 204, FITS AND CLEARANCES

REF. NO.	Name	Dim. for Ref. (inches) Min.	Dim. for Ref. (inches) Max.	Limits (inches) Min.	Limits (inches) Max.	Limits (inches) Replace
1001	JT15D-5 (Pre-SB7390) Shaft, Compressor Inlet Cone, Assembly	1.4400	1.4410	0.0016	0.0009T	
	Cone, Compressor Inlet, Inner Assembly	1.4401	1.4416			
1001	JT15D-5 (Post-SB7390) and JT15D-5R Shaft, Compressor Inlet Cone, Assembly	1.4400	1.4406	0.0016	0.0005T	
	Cone, Compressor Inlet, Inner Assembly	1.4401	1.4416			
1007	Shaft, LP Compressor	0.0456	0.0476			
	Hub, LP Compressor Rotor	0.0491	0.0511	0.0015	0.0055	
1022	JT15D-5 (Pre-SB7234) Blade, LP Compressor Rotor (Radial Tip Clearance) (FIT TO): LEADING EDGE			0.0400	0.1000	
	NOTE: TRAILING EDGE Radial Tip Clearance Limits: 0.0500 Min. to 0.1200 Max.					
1022	JT15D-5 (Post-SB7234) and JT15D-5R Blade, LP Compressor Rotor (Radial Tip Clearance) (FIT TO): LEADING EDGE			0.0500	0.0600	
	NOTE: TRAILING EDGE Radial Tip Clearance Limits: 0.8500 Min. to 0.1000 Max.					

TABLE 204, FITS AND CLEARANCES (Cont'd)

REF. NO.	Name	Dim. for Ref. (inches) Min.	Dim. for Ref. (inches) Max.	Limits (inches) Min.	Limits (inches) Max.	Limits (inches) Replace
1022	JT15D-5 (Post-SB7368) and JT15D-5R Blade, LP Compressor Rotor (Radial Tip Clearance) (FIT TO) Leading Edge			0.0600	0.0700	
1228	Cone, Compressor Inlet, Inner Assembly	1.4401	1.4416	0.0001	0.0036	
	Spacer, Compressor Inlet Cone	1.4380	1.4400			
1229	Shaft, LP Compressor	1.8988	1.8998	0.0010T	0.0030T	
	Hub, LP Compressor Rotor	1.8968	1.8978			
1232	JT15D-5 (Pre-SB7444): Shaft, LP Compressor	2.1145	2.1149	0.0015T	0.0029T	
	Hub Fan	2.1120	2.1130			
1232	JT15D-5 (Post-SB7444) and JT15D-5R: Shaft, LP Compressor	2.1145	2.1151	0.0005T	0.0031T	
	Hub Fan	2.1120	2.1140			
1233	JT15D-5 (Pre-SB7444): Spacer, Flat	2.1165	2.1185	0.0016	0.0040	
	Shaft, LP Compressor	2.1145	2.1149			
1233	JT15D-5 (Post-SB7444) and JT15D-5R: Spacer, Flat	2.1165	2.1185	0.0014	0.0040	
	Shaft, LP Compressor	2.1145	2.1151			

TABLE 205, TORQUE AND STRETCH

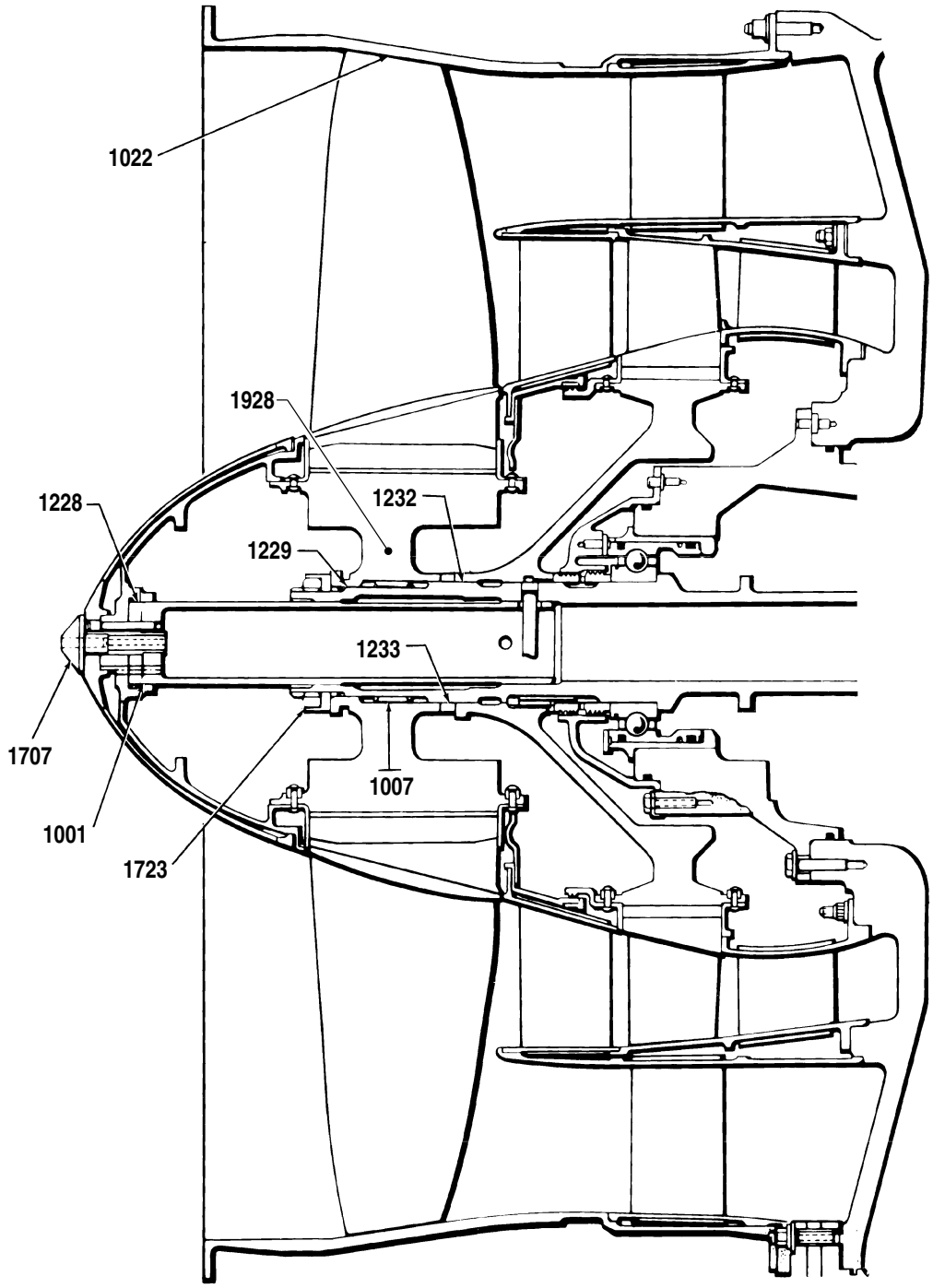
REF. NO.	Name	Limits Min.	Limits Max.
1707	Bolt - Compressor Inlet Cone		
	(1) Lubricate thread and thrust face with anti-seize compound (PWC06-004).		
	(2) Torque to 140 to 170 lb.in.		
1723	Hub Locknut - LP Compressor		
	(1) Torque to 2800 to 3000 lb.in.		
	(2) Loosen to zero lb.in.		
	(3) Lubricate threads and thrust face of washer and nut with anti-seize compound (PWC06-004).		
	(4) Torque to 2800 to 3000 lb.in.		

TABLE 206, SPRING PRESSURE

REF. NO.	Name	Limits Min.	Limits Max.
	Not Applicable		

TABLE 207, SPECIAL ASSEMBLY

REF. NO.	Name	Limits Min.	Limits Max.
1928	LP Compresssor Rotor Assembly		
	(1) Install fan assembly on LP compressor shaft, and apply an axial load of 6900 to 7900 lbf (2500 to 2800 psi).		
	NOTE: The load-to-psi conversion is derived from the cylinder effective area of approved hydraulic cylinder (PWC89837).		
	(2) Maintain load until parts cools to room temperature.		
	(3) Remove axial load.		



JT15D-5 SHOWN (JT15D-5R SIMILAR) C21489A

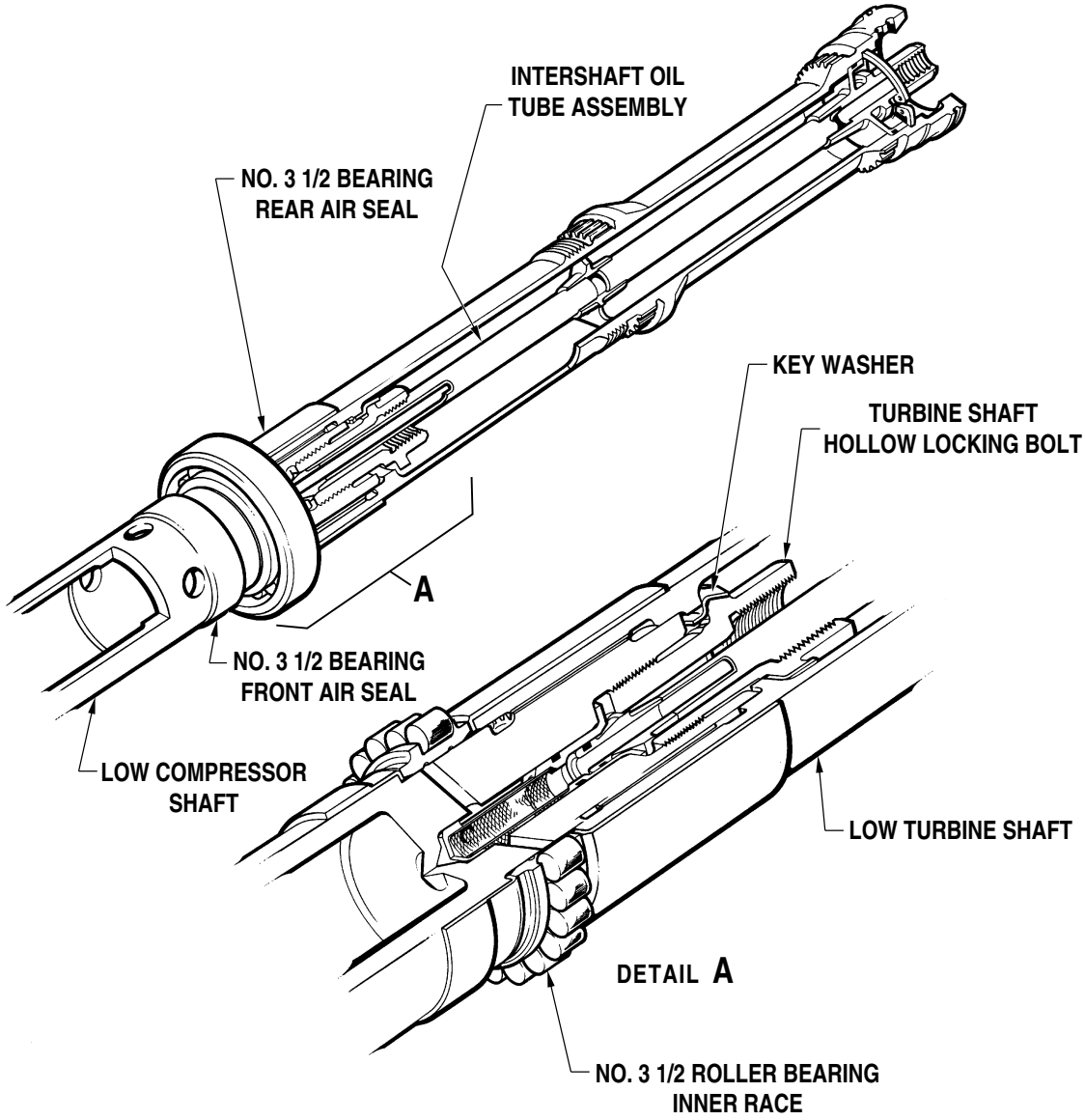
Fits, Clearances and Torque Loadings
Figure 205

NO.1 BEARING AND N1 SPEED SENSING - DESCRIPTION AND OPERATION

1. LP Compressor Shaft, No.1 Bearing and N1 Speed Sensing (Ref. Fig. 1)

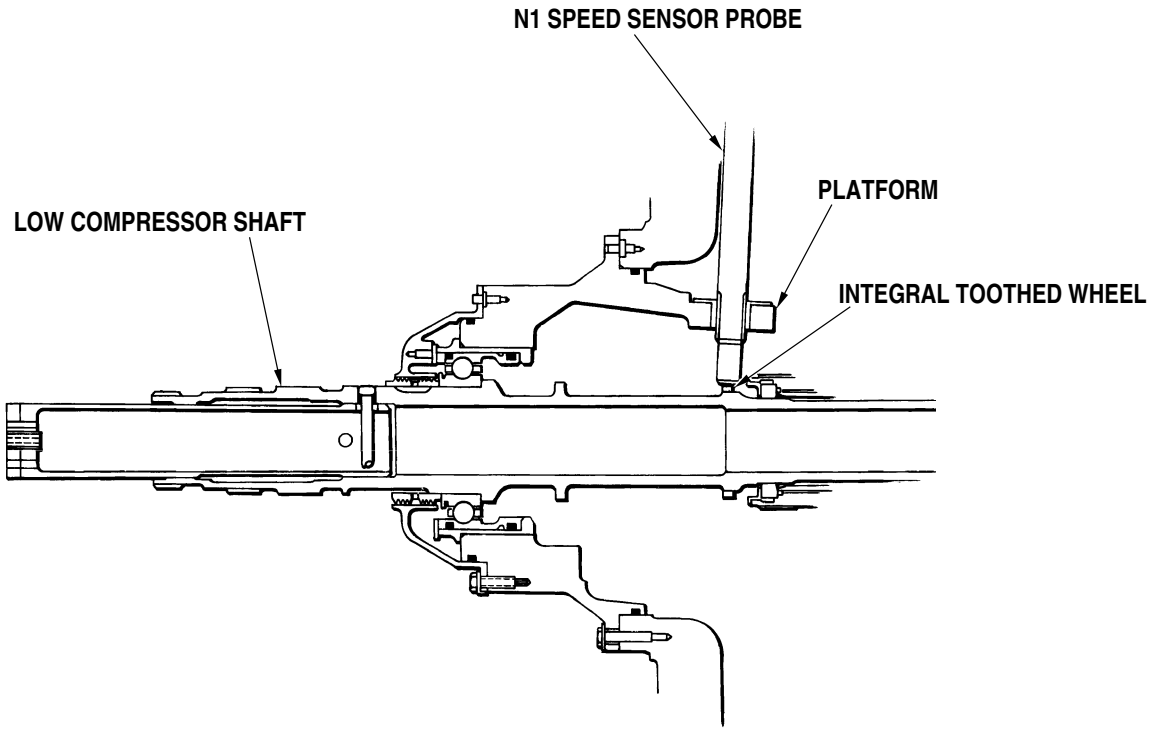
   The LP compressor shaft system, supported by No.1 ball bearing, No. 3-½ intershaft roller bearing, and No.4 roller bearing (Ref. 72-00-00, DESCRIPTION AND OPERATION) consists of a three-piece tubular shaft comprising the LP turbine shaft (rear), the LP compressor shaft (center), and the LP compressor inlet cone shaft (front). The rear spline of the center shaft mates with the front inner spline of the rear shaft, and both are joined by a hollow turbine shaft locking bolt that screws into the center shaft and is locked by a keywasher. The inlet cone shaft forms an extension to the low pressure compressor shaft to which it is secured by two stainless steel straight pins. The low pressure turbine shaft houses an oil transfer tube assembly to provide lubrication to the No.3-½ bearing.

   The N1 speed sensor is supported by a platform which is an integral part of No.1 bearing housing (Ref. Fig. 2).



C12639

Low Pressure Compressor Turbine Shaft and Low Pressure Compressor Shaft Interconnection (Typical)
Figure 1



C11406A

N1 Speed Sensor Probe
Figure 2

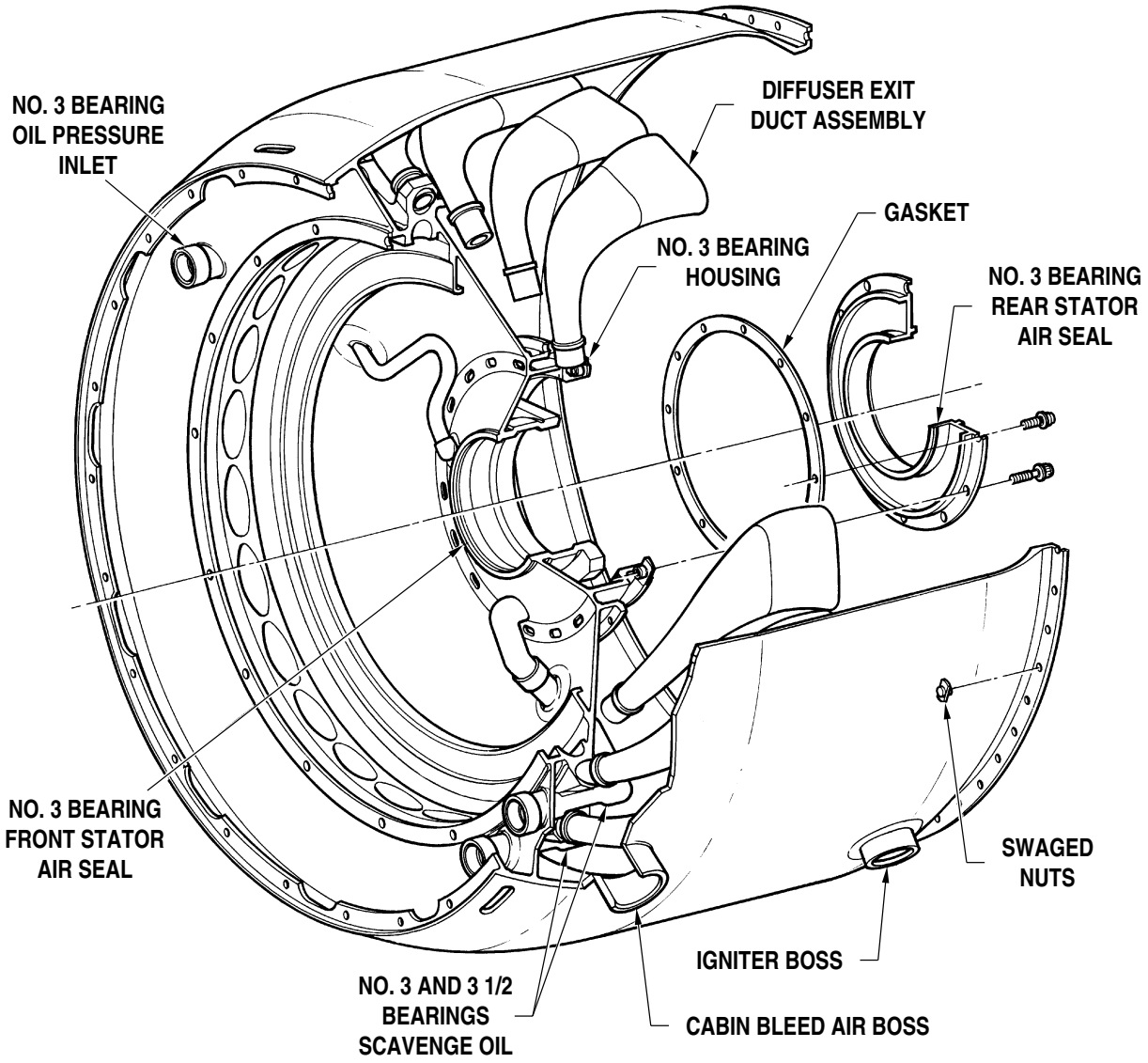
GAS GENERATOR CASE - DESCRIPTION AND OPERATION

1. Description (Ref. Fig. 1)

The gas generator case is a stainless steel fabrication consisting of a cylindrical section with front and rear flanges and a one-piece weldment embodying an inner and outer cone joined by a diffuser off-take section. The front flange is bolted to the intermediate case and the rear flange supports the low pressure turbine stator support assembly. A weldment coning inward and rearward from the front flange forms the No.3 bearing housing at its center, and supports the impeller housing, the twenty-four duct diffuser assembly, and the combustion chamber large exit duct assembly. The impeller housing provides support for the bleed valve and linkage assembly.

The No.3 bearing housing supports the No.3 roller bearing outer race, the oil nozzle assembly and the front section of No.3 bearing rear stator air seal. The No.3 bearing housing embodies a heat shield which provides thermal protection for the bearing cavity. The high pressure turbine seal assembly, which mounts the high pressure turbine baffle, is supported from the outer flange of the No.3 bearing housing. The housing locates the input end of the No.3 bearing pressure oil tube and the inlet end of the scavenge oil tubes for No.3 and 3-½ bearings.

The cylindrical section of the gas generator case forms the outer housing for the combustion chamber liner. Outer surface bosses are provided for the installation of two spark igniters, two cabin air bleed connections, one compressor discharge pressure outlet for the fuel system, one hot air outlet for the anti-icing system and two fuel drain outlets.


NO. 3 BEARING OIL PRESSURE INLET
DIFFUSER EXIT DUCT ASSEMBLY
GASKET
NO. 3 BEARING HOUSING
NO. 3 BEARING REAR STATOR AIR SEAL
NO. 3 BEARING FRONT STATOR AIR SEAL
SWAGED NUTS
IGNITER BOSS
NO. 3 AND 3 1/2 BEARINGS SCAVENGE OIL
CABIN BLEED AIR BOSS

C11461

Gas Generator Case
Figure 1

GAS GENERATOR CASE - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the gas generator case.

2. Consumable Materials

   Not Applicable

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Inspection/Check (Ref. Fig. 201)

   A. Procedure

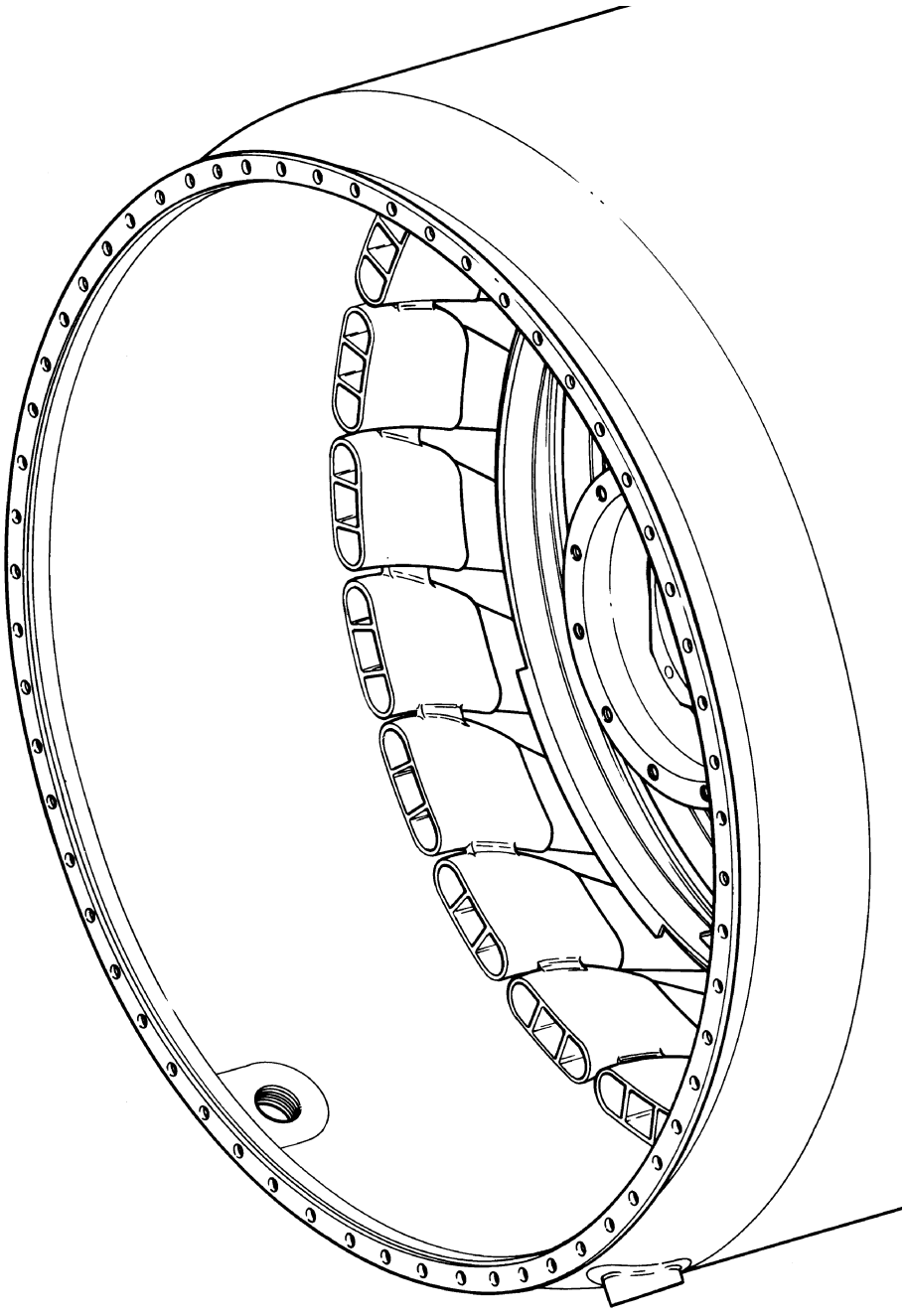
      (1) Inspect internal flanges of gas generator case for cracks. If cracks are evident, return engine to an approved overhaul facility for repair.

      (2) Inspect diffuser exit ducts in gas generator case, as follows:

         (a) Check that a minimum of 0.100 inch clearance exists between each duct.

         (b) Inspect welds joining ducts for cracks. If cracks are evident, return engine to an approved overhaul facility for repair.

         (c) Inspect ducts for cracks. If cracks are evident, return engine to an approved overhaul facility for repair.



C17747

Diffuser Exit Duct- Inspection
Figure 201

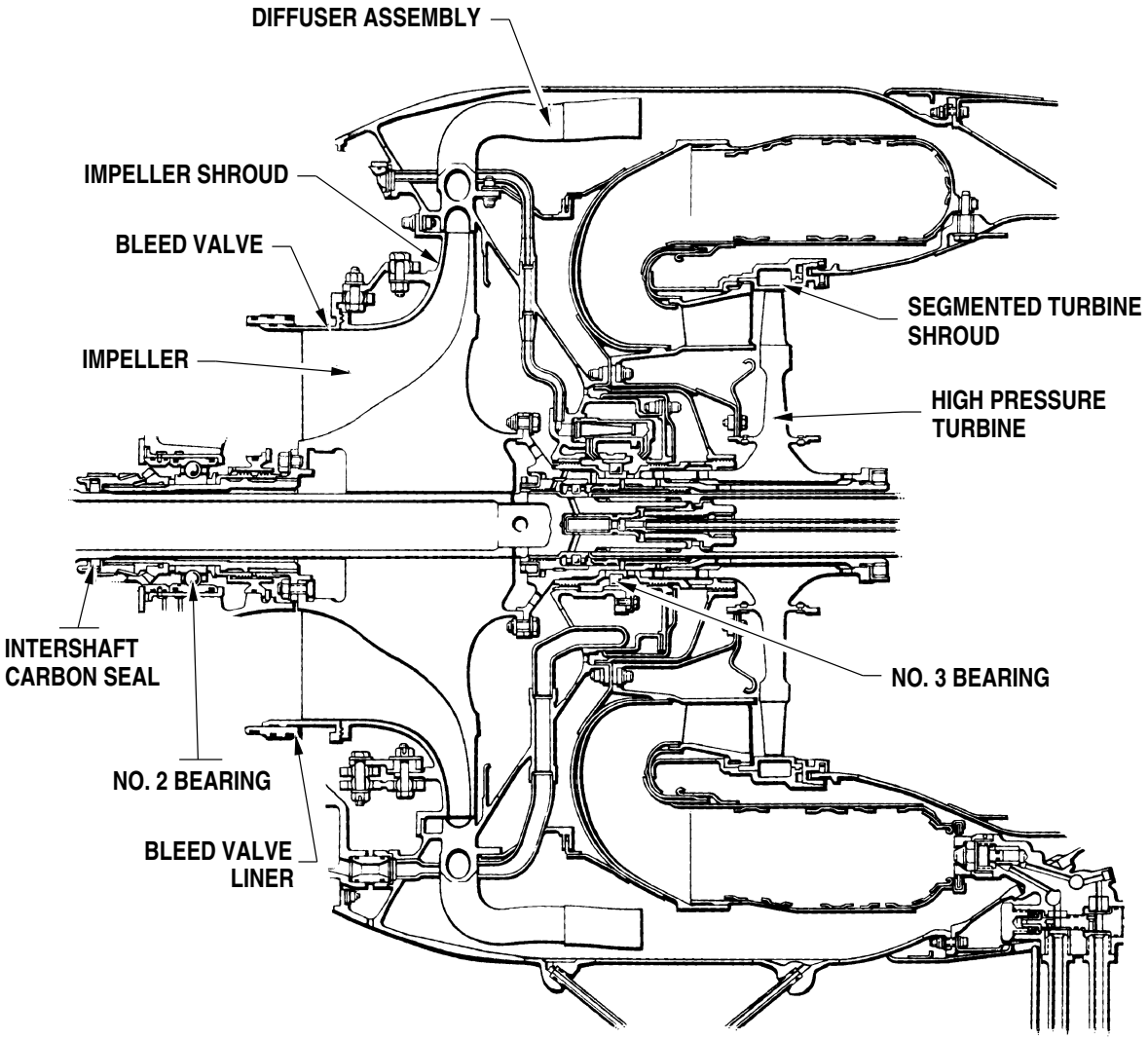
HIGH PRESSURE COMPRESSOR ASSEMBLY - DESCRIPTION AND OPERATION

1. Description (Ref. Fig. 1)

The high pressure compressor consists of a single, forged titanium impeller, incorporating 16 full vanes and 16 splitter vanes, an impeller shroud, and a diffuser assembly incorporating 24 tubes with integral cast exit duct.

The airflow is accelerated and directed by the impeller to the diffuser which converts the kinetic energy generated by the impeller to high pressure energy at low velocity. The airflow is contained within the impeller by the impeller shroud. The air leaving the diffuser passes through the deflector assembly to the combustion chamber liner.

Forward, the impeller is attached to a stubshaft which is supported by the No.2 bearing. At the rear, the impeller is supported by the high pressure rotor shaft and the No.3 bearing. Thus, the impeller also serves to link the high pressure rotor shaft with the stubshaft. The front of the stubshaft supports an intershaft carbon seal to contain oil in the area of the No.1 and No.2 bearings.



C11436A

High Pressure Compressor Rotor (Typical)
Figure 1

HIGH PRESSURE COMPRESSOR ASSEMBLY - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the high pressure compressor assembly.

2. Consumable Materials

   Not Applicable

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Inspection/Check

   A. Procedure (Ref. Fig. 201)

      (1) Inspect impeller for damage using a suitable borescope:

         (a) Minor damage to impeller vane leading edge is permitted (Ref. Table 201).

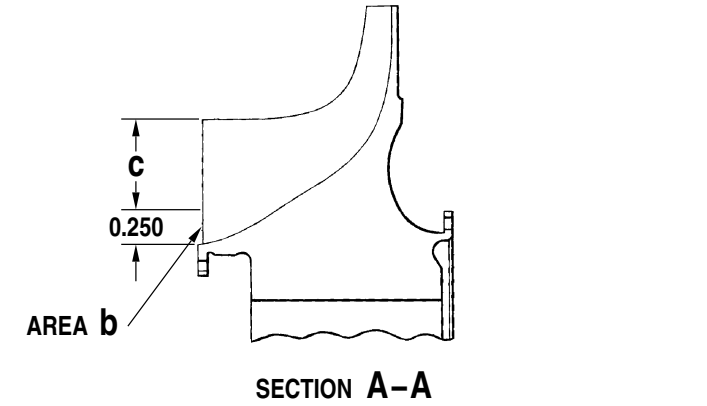
            NOTE: Estimate depth of damage by comparing depth of nick or dent to vane leading edge radius of 0.015 inch.

         (b) Impeller damage may only be repaired at an approved overhaul facility.

TABLE 201, HP Compressor Vane Leading Edge Inspection

LOCATION	MAXIMUM ALLOWABLE	CORRECTIVE ACTION
Area b	No damage allowed	*
Area c	Three nicks or dents per vane up to 0.030 inch deep	*

* Return engine to an approved overhaul facility for inspection and repair.



C22796A

HP Compressor Vane Leading Edge - Inspection
Figure 201

LP COMPRESSOR BLEED AIR SYSTEM - DESCRIPTION AND OPERATION

1. Compressor Bleed System (Ref. Fig. 1)

The compressor bleed system comprises a bleed valve, bleed valve linkage, an actuating rod, a hydraulically operated actuator and an electrical circuit.

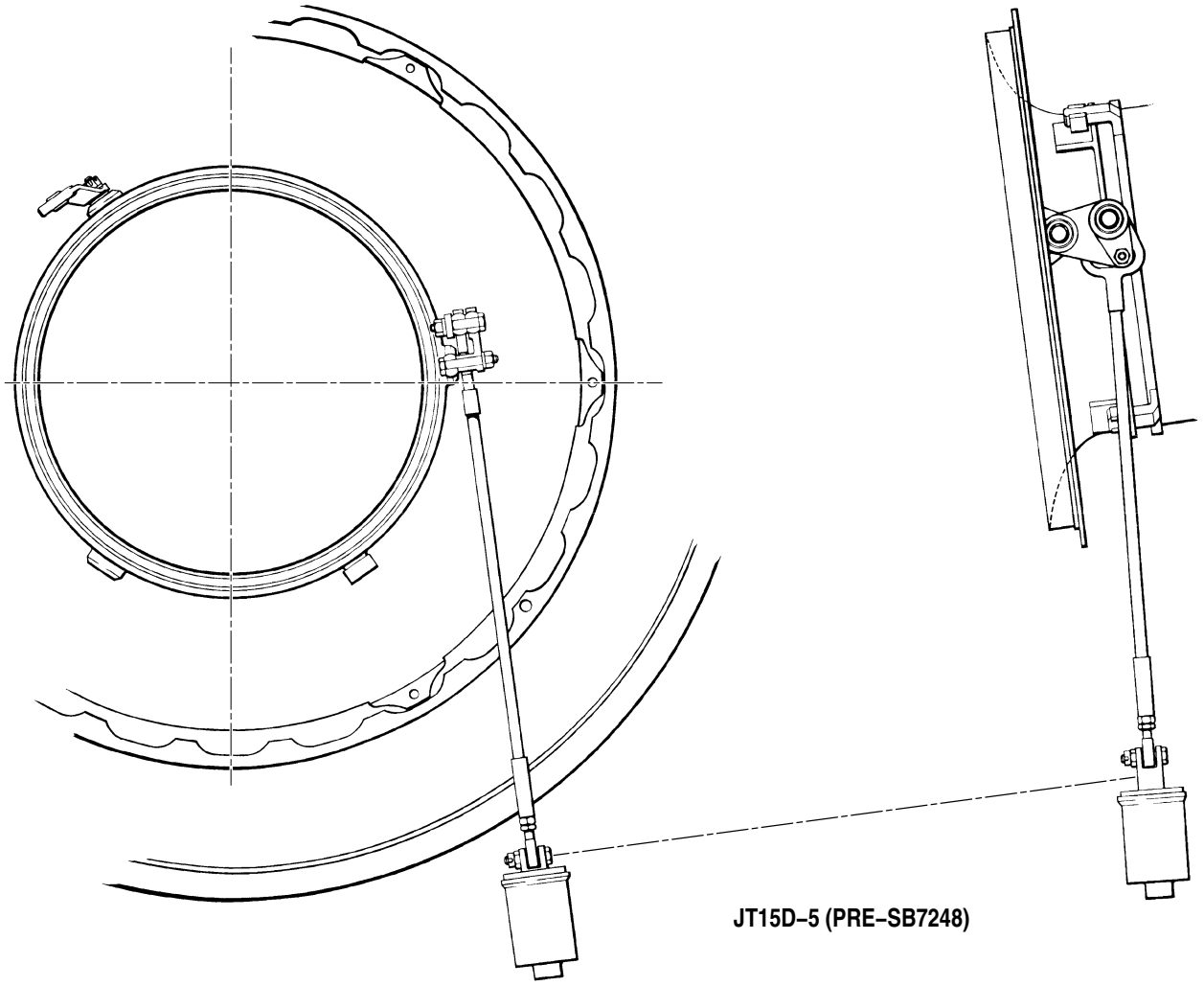
The annular configuration bleed valve is located in the primary gas path bore in the rear of the intermediate case, where it surrounds the front of the HP compressor impeller. Three equally-spaced roller tracks on the impeller housing support the roller assemblies on the bleed valve. An adjustable actuating rod is connected between the master link assembly and the hydraulic actuator. On JT15D-5 (Post-SB7248) and JT15D-5R engines, an actuating rod boot protector is installed on the outer bypass duct The piston/cylinder type actuator mounted between the fuel pump and HMU uses fuel supplied by the engine fuel pump as a working medium (Ref. 73-10-12).

The electrical system required to initiate the bleed valve comprises an engine wiring harness and a solenoid-operated actuator. A sensor, sensitive to temperature and compressor rpm, is installed in the air intake duct.

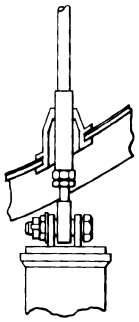
A sealing ring, located in and bonded to a channel in the bleed valve rear face, abuts the impeller housing inner flange when the valve is in the closed position. The front face of the valve abuts a similar sealing ring housed in a channel at the inner circumference of the oil tank cover.

2. Bleed System Operation

Should compressor surge occur at altitude during engine deceleration, the air intake speed/temperature sensor will transmit an electrical signal to the solenoid-operated actuator. Fuel under pressure from the engine-driven fuel pump is admitted to the actuator to move the actuator piston and consequently the actuating rod. The bleed valve master linkage, connected to the actuating rod, moves the valve in an axial direction to the open piston, allowing compressor air to bleed into the bypass duct. When a stable airflow condition is achieved, deactivation of the signal permits fuel pressure to be released and allows the bleed valve to return to the closed position, thus restoring the normal primary air flow path through the high pressure impeller.



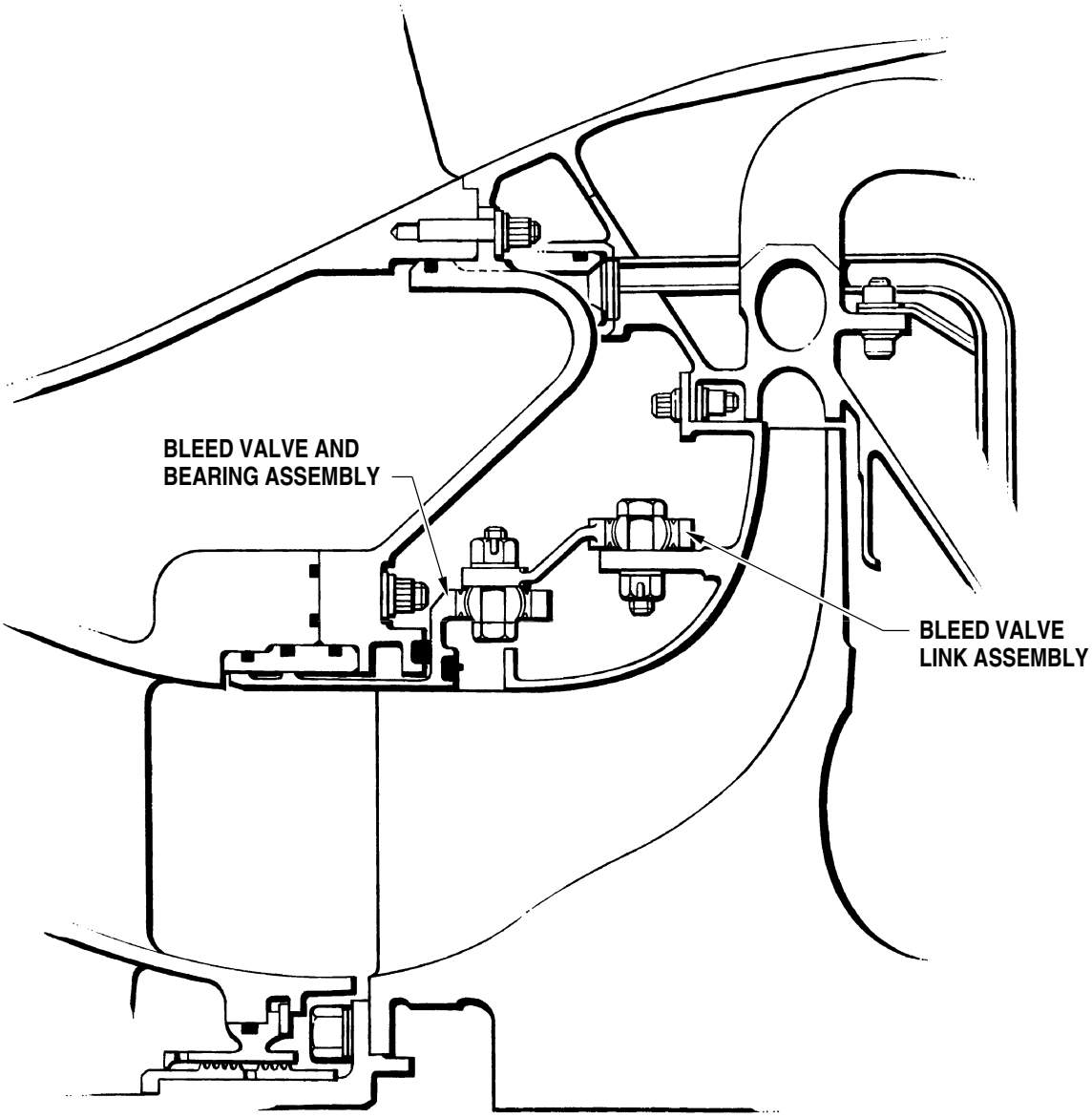
JT15D–5 (PRE–SB7248)



JT15D–5 (POST–SB7248)
AND JT15D–5R

C11404B

Compressor Bleed Valve
Figure 1 (Sheet 1 of 2)



C11433

Compressor Bleed Valve
Figure 1 (Sheet 2)

COMPRESSOR BLEED VALVE - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the compressor bleed valve.

2. Consumable Materials

   Not Applicable

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Adjustment/Test

   A. Rigging of Bleed Valve (Ref. Fig. 201):

      (1) Rig bleed valve open:

         (a) Disconnect actuator (1) from bleed valve linkage rod end bearing (6) by removing cotterpin (3), castellated nut (4), washer (5) and bolt (7).

         (b) Open bleed valve fully by pushing bleed valve linkage.

         (c) Fully extend bleed valve actuator and position linkage rod spherical bearing end (6) in fork-end of actuator (1).

         (d) Loosen locknut (8) and adjust rod end until it is coincident with fork end and install bolt (7). Tighten nut (8) and secure with lockwire. This ensures bleed valve is fully open when actuator is fully extended, i.e. no overtravel.

      (2) Rig bleed valve closed:

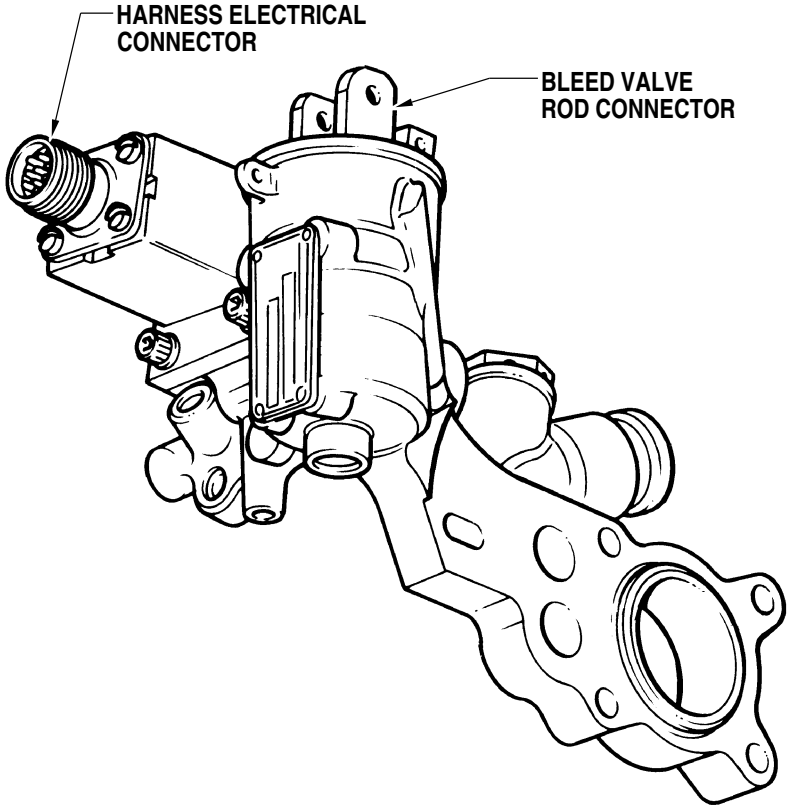
         (a) Remove bolt (7) connecting linkage to actuator (1).

         (b) Fully retract actuator ensuring adjustment screw in bottom of actuator is all the way out (counterclockwise).

         (c) Close bleed valve by extending (pulling) bleed valve linkage and position linkage rod end (6) in between fork end of actuator (1).

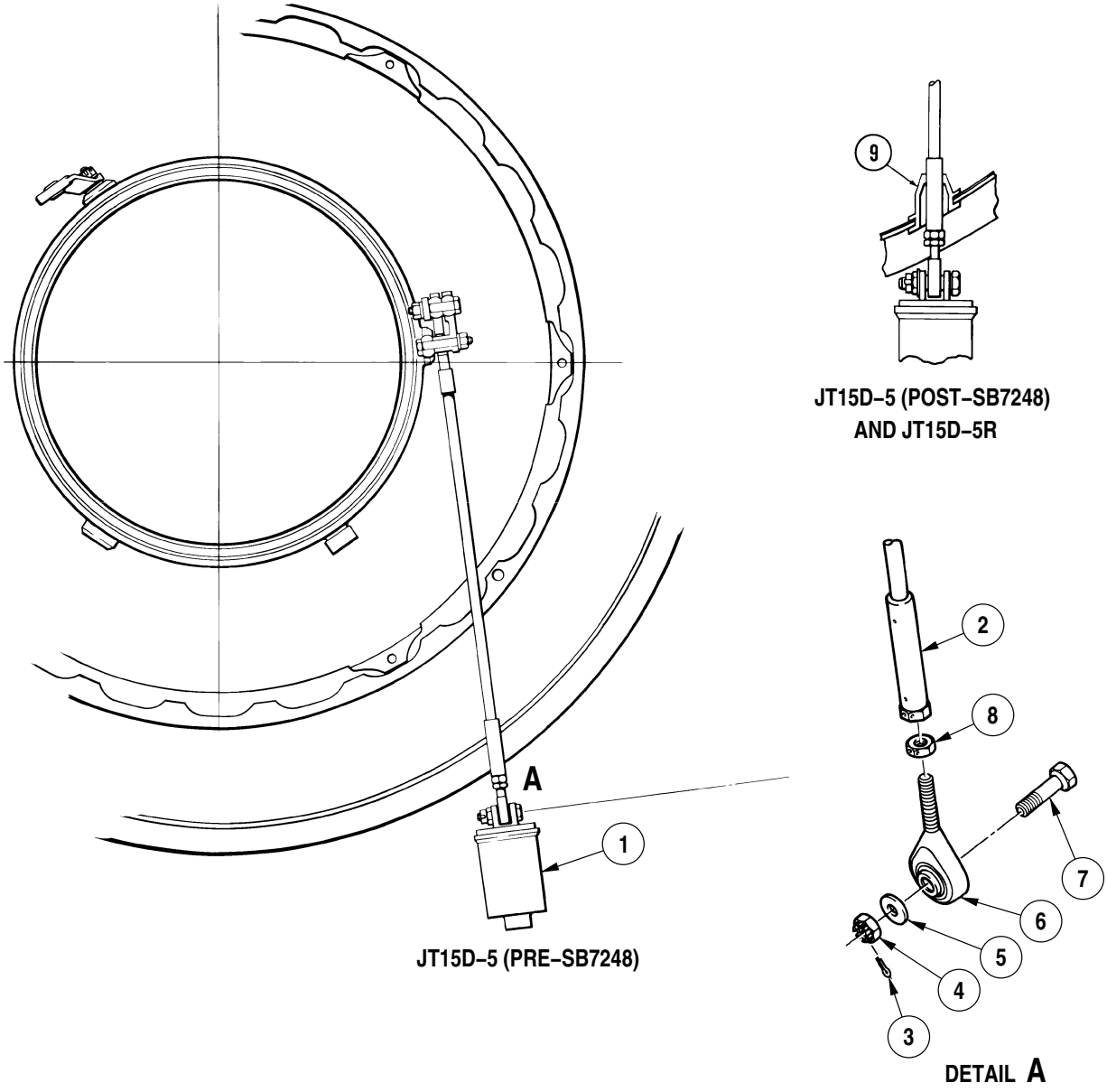
         (d) Actuator stroke will require shortening by adjustment of the external stop on the actuator. Insert Allen key and turn external stop in a clockwise direction until rod end and fork end of actuator are coincident and reinstall bolt (7).

         (e) Back out external stop one half (1/2) turn counterclockwise. This ensures bleed valve is held positively closed by fuel pressure.



C11561

Bleed Valve Rigging
Figure 201 (Sheet 1 of 2)



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Bleed Valve Rigging
Figure 201 (Sheet 2)

Key to Figure 201

1. Actuator
2. Linkage Rod End
3. Cotterpin
4. Castellated Nut
5. Washer
6. Rod End Bearing
7. Bolt
8. Nut
9. Protective Boot, JT15D-5 (Post-SB7248) and JT15D-5R

(f) Install flat washer (5) and castellated nut (4), tighten and torque nut to 24 to 36 lb.in. and secure with cotterpin (3).

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
LEP	1	Oct 06/2006
	2 blank	Oct 06/2006
Contents	1	Oct 06/2006
	2 blank	Oct 06/2006
72-40-00	1	Oct 06/2006
Description and Operation	2	Oct 06/2006
72-40-01	1	Oct 06/2006
Description and	2	Oct 06/2006
Operation	3	Oct 06/2006
	4 blank	Oct 06/2006
72-40-01	201	Oct 06/2006
Maintenance	202	Oct 06/2006
Practices	203	Oct 06/2006
	204	Oct 06/2006
	205	Oct 06/2006
	206	Oct 06/2006
	207	Oct 06/2006
	208	Oct 06/2006
	209	Oct 06/2006
	210	Oct 06/2006
	211	Oct 06/2006
	212	Oct 06/2006
	213	Oct 06/2006
	214	Oct 06/2006
	215	Oct 06/2006
	216 blank	Oct 06/2006

TABLE OF CONTENTS

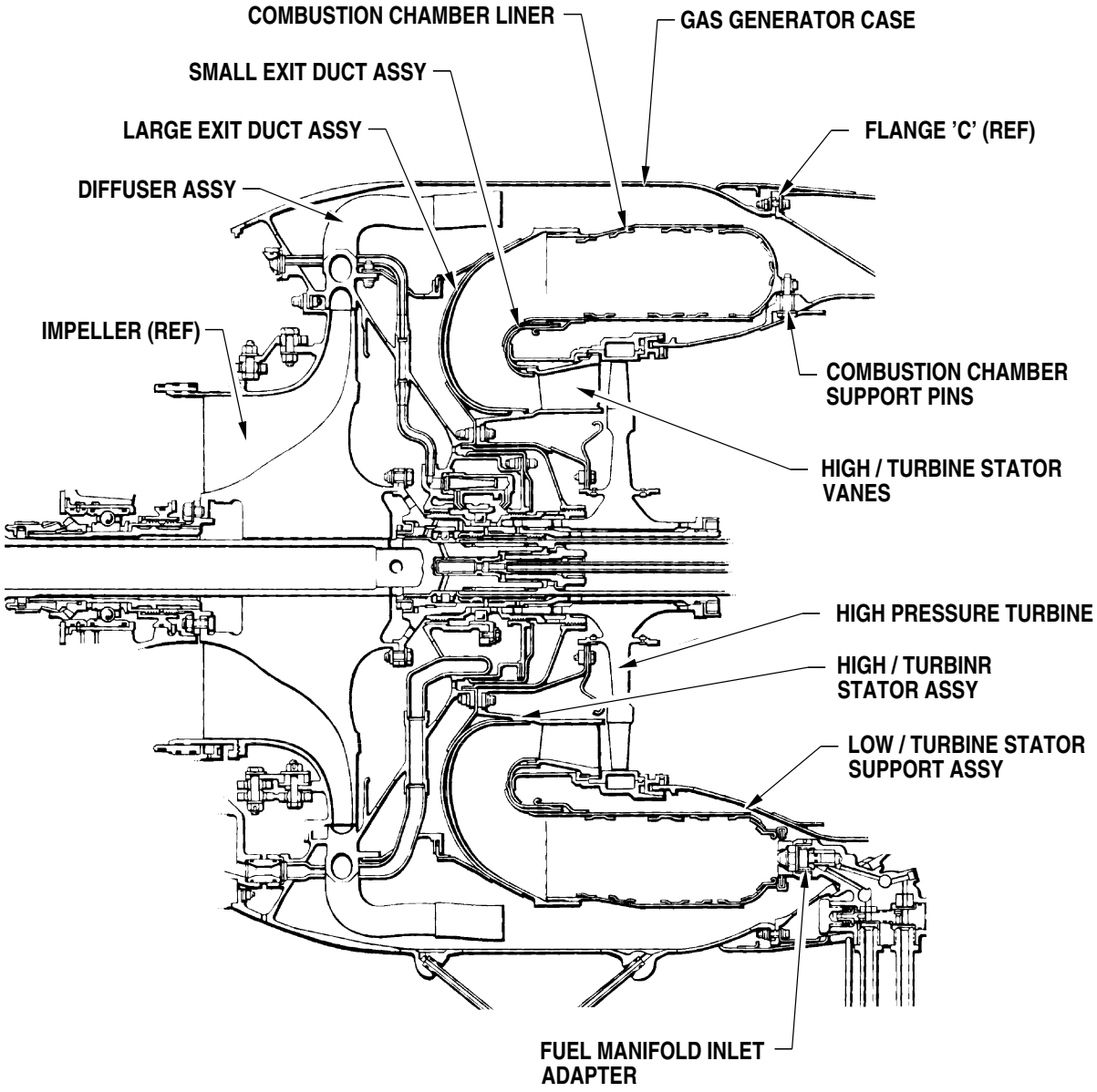
SUBJECT	PAGE
COMBUSTION SECTION - DESCRIPTION AND OPERATION	**72-40-00**
1. Combustion Section	1
COMBUSTION CHAMBER, LPT ST. SUPPORT- DESCRIPTION AND OPERATION	**72-40-01**
1. Combustion Chamber Liner	1
2. LP Turbine Stator Support	1
COMBUSTION CHAMBER, LPT STATOR SUPPORT - MAINTENANCE PRACTICES	**72-40-01**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation (Heavy Maintenance Only)	201
A. Removal of LP Turbine Stator Support Assembly and Combustion Chamber Liner	201
B. Pre-assembly of LP Turbine Stator Assembly and Combustion Chamber Liner	203
C. Installation of LP Turbine Stator Assembly and Combustion Chamber Liner	204
6. Inspection/Check	205
A. LP Turbine Stator Support Assembly - Wear and Fretting	205
B. Combustion Chamber Liner and Support Pins	205
7. Approved Repairs	211
A. Crack Repair by Welding	211
B. Cooling Ring Repair	211
8. Fits, Clearances and Torque Loadings	211

COMBUSTION SECTION - DESCRIPTION AND OPERATION

1. Combustion Section (Ref. Fig. 1)

The engine combustion section is contained in the rear section of the gas generator case and is comprised of the combustion chamber liner and the small and large exit ducts (Ref. Fig. 1). The large exit duct is secured at the forward end of the gas generator case. The small exit duct locates with the high pressure turbine stator assembly and the LP turbine stator support assembly. The forward end of the combustion chamber liner locates with the small and large exit ducts whereas the rear end is located by support pins entered from the LP turbine stator support assembly.

Compressor discharge air is directed from the diffuser section and discharges into the combustion chamber through metered holes where it is mixed with fuel from the manifold and ignited. The expanding gases flow forward into the exit duct where they are turned inward through 180 degrees, then through the HP turbine stator vanes to the HP turbine.



TYPICAL C11435A

Combustion Section
Figure 1

COMBUSTION CHAMBER, LPT ST. SUPPORT- DESCRIPTION AND OPERATION

1. Combustion Chamber Liner (Ref. Figs. 1 and 2)

The reverse-flow combustion chamber liner is contained within the gas generator case and consists of an annular nickel alloy weldment having concentric inner and outer walls. The front end is open, the rear end is domed. Six equally spaced radially disposed mounted lugs and 12 floating washer housing assemblies located around the domed end of liner are provided for insertion of fuel nozzle adapters. Two similar housings at the 5 and 7 o'clock positions provide for insertion of spark igniters. The floating housings allow liner expansion and contraction during engine operation.

A series of perforations allows air to enter the liner in a manner designed to provide the best fuel/air ratios for engine starting and sustained combustion with minimum exhaust smoke. Airflow direction is controlled by cooling rings. The perforations ensure uniform temperature distribution at the HP compressor turbine inlet. The front end of the liner mates with and is supported by the small and large combustion chamber exit duct assemblies. The rear end is located and supported by six support pins installed through bosses on the LP turbine support assembly. The threaded pins are secured in the support assembly by six tabwashers.

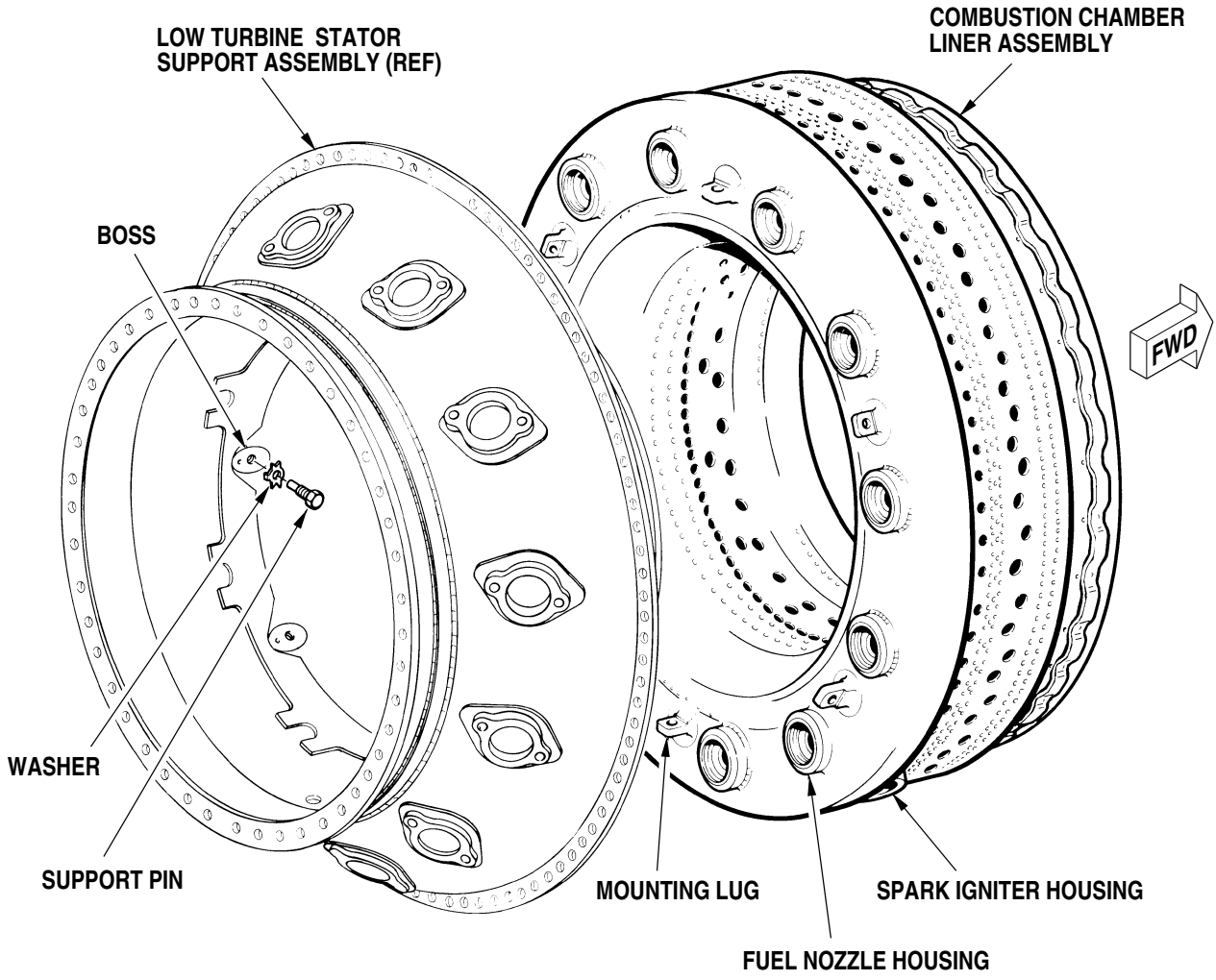
The outer exit duct and heat shield assembly reverses the gas flow from the combustion chamber and directs it to the HP turbine stator vanes. A flange incorporating four lugs welded to the convex surface of the heat shield, engages with a slotted support ring attached to the diffuser assembly, and restrains the duct axially. The center section of the duct assembly is bolted with the HP turbine stator assembly to the No.3 bearing housing. The heat shield forms a cavity which is allowed to breathe with changing temperature.

The small exit duct assembly assists the large exit duct assembly in diverting the gas flow to the HP turbine stator vanes. It consists of an overlapping sheet metal assembly with an enlarged flange at the rear which forms the housing for the HP turbine stator assembly and the HP turbine shroud segments. A shroud support ring is riveted to this housing; the housing has an annular groove that supports an interstage sealing ring. The space provided by the sheet metal overlap allows the passage of cooling air through the duct.

2. LP Turbine Stator Support (Ref. Fig. 1)

The LP turbine stator support assembly consists of a nickel alloy weldment with the front flange bolted to the gas generator case assembly (Flange C), and rear flange bolted to, and supporting, the turbine exhaust duct assembly (Flange D). The weldment consists of inner and outer opposing cones joined at flange D. The forward edge of the inner cone fits over the interstage sealing ring. The outer cone provides mounting for the six support pins and tab-washers for the combustion chamber liner, while 12 bosses mount the fuel manifold adapter assemblies.

A drain hole towards the rear of the inner cone at the 6 o'clock position allows residual fuel, accumulating in the cavity below the LP turbine interstage stator, to drain into the gas generator case and then overboard through the gas generator case drain valve.



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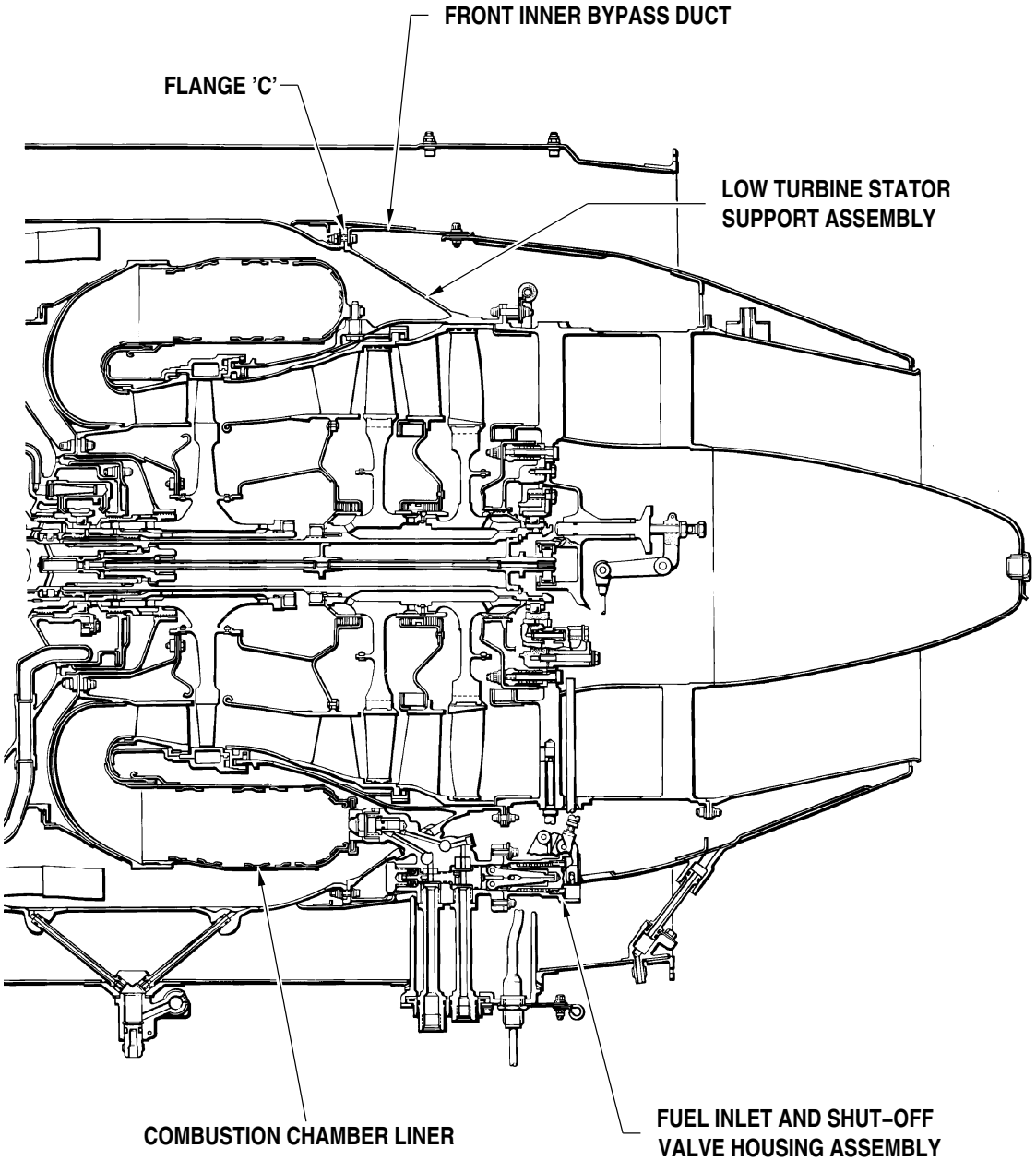
Combustion Chamber Liner
Figure 1


FRONT INNER BYPASS DUCT
FLANGE 'C'
LOW TURBINE STATOR SUPPORT ASSEMBLY
COMBUSTION CHAMBER LINER
FUEL INLET AND SHUT–OFF VALVE HOUSING ASSEMBLY

TYPICAL

C11444

LP Turbine Stator Support and Combustion Chamber Liner
Figure 2

COMBUSTION CHAMBER, LPT STATOR SUPPORT - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the combustion chamber and LP turbine stator support assembly.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC05-151	Filler Rod

3. Special Tools

   The special tools listed below are used in the following procedures.

Tool No.	Name
PWC31058	Adapter
PWC31195	Adapter

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation (Heavy Maintenance Only)

   A. Removal of LP Turbine Stator Support Assembly and Combustion Chamber Liner (Ref. Fig. 201)

      (1) Remove turbine exhaust duct and No. 4 bearing housing assembly (Ref. 72-50-06).

      (2) Remove LP turbine rotor balancing assembly (Ref. 72-50-03).

      (3) Remove spark igniters (Ref. 74-20-02).

      (4) Remove primary and secondary fuel pressure tubes and associated fairing (Ref. 73-10-03).

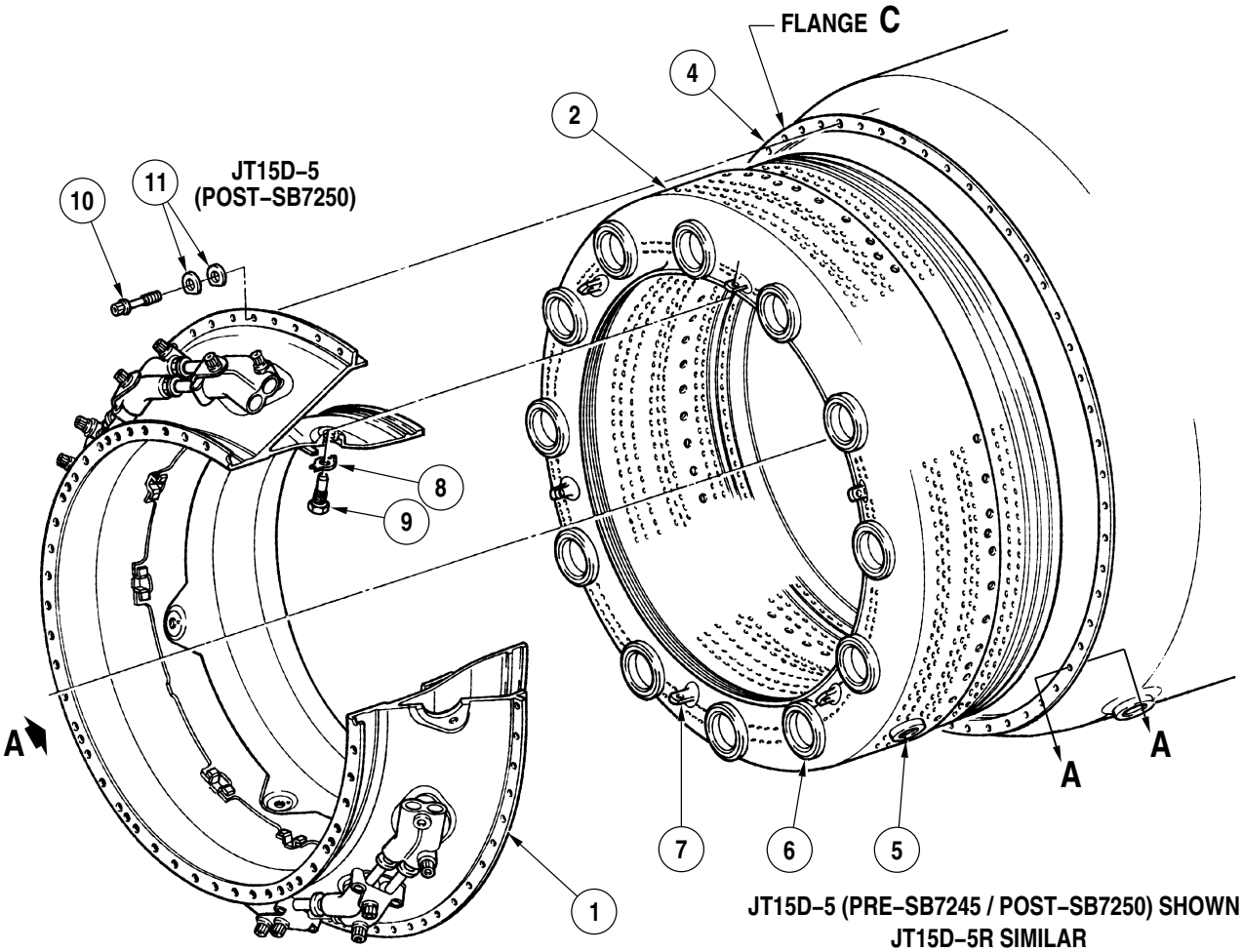
      (5) Remove rear engine mount (Ref. 72-70-04).

      (6) Remove front inner bypass duct assembly (Ref. 72-70-01).

      (7) Remove bolts (10) and, if applicable, washers (11), from Flange C. Retain or discard Flange C bolts at Hot Section Inspection (HSI) as follows:

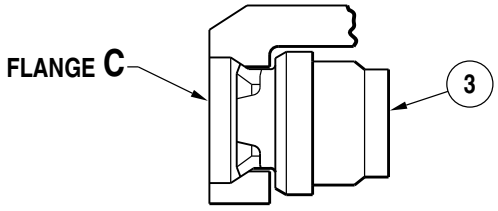
         (a) For JT15D-5 (Pre-SB7249/Pre-SB7245/Post-SB7250/Pre-SB7324) engines: Discard 15 bolts and retain 30 washers (11) (two for each bolt) at HSI.

         (b) For JT15D-5 (Post-SB7249/Pre-SB7324) engines with P/N MS9696-09 bolts, and JT15D-5 (Post-SB7245/Pre-SB7324) engines: Discard 45 bolts at HSI.



JT15D–5 (PRE–SB7245 / POST–SB7250) SHOWN
JT15D–5R SIMILAR

JT15D–5 (PRE–SB7245 / POST–SB7250)
JT15D–5R SIMILAR



SECTION A–A

C11469E

Removal/Installation - Combustion Chamber Liner and Low Turbine Stator Support Assembly
Figure 201

Key to Figure 201

1. LP Turbine Stator Support Assembly
2. Combustion Chamber Liner
3. Swaged Shanknut
4. Gas Generator Case
5. Igniter Plug Housing
6. Fuel Nozzle Housing
7. Combustion Liner Support Bosses
8. Keywasher
9. Support Pin
10. Bolt
11. Washer, JT15D-5 (Post-SB7250)

(c) For JT15D-5 (Post-SB7249/Pre-SB7324) engines with P/N 3111850-01 bolts (10) and JT15D-5 (Post-SB7324) or JT15D-5R engines: Retain 45 bolts at HSI.

CAUTION: IF ENGINE IS ON AIRCRAFT, SECURE REAR MOUNT ADAPTER (PWC31058) TO GAS GENERATOR CASE AND TO AIRCRAFT REAR ENGINE MOUNT AFTER REMOVAL OF ASSEMBLED SUPPORT AND LINER.

(8) Remove assembled LP turbine stator support (1) and combustion chamber liner (2) and place on a clean, level wooden surface with combustion chamber down.

(9) Separate the combustion chamber liner (Ref. Fig. 201) from the LP turbine stator support assembly as follows:

(a) Remove six keywashers (8) and support pins (9) from low pressure turbine stator assembly.

(b) Position LP turbine stator support assembly (1) with open end of combustion chamber liner assembly (2) facing up and remove liner.

B. Pre-assembly of LP Turbine Stator Assembly and Combustion Chamber Liner (Ref. Fig. 201)

(1) Assemble combustion chamber liner assembly (2) and LP turbine stator support (1) on a bench.

(2) Position combustion chamber liner assembly (2) on LP turbine stator support (1). Align spark igniter holes with igniter plug housings (5) at 5 and 7 o'clock positions.

(3) Install keywashers (8) on support pins (9) and install six support pins (9) into bosses in LP turbine support assembly through bosses on dome of combustion chamber liner. Tighten and torque support pins to 225 to 300 lb.in. and lock keywashers.

C. Installation of LP Turbine Stator Assembly and Combustion Chamber Liner (Ref. Fig. 201)

(1) Check all Flange C shank nuts (3) on gas generator case (4). Replace missing or damaged nut (Ref. 70-00-00, REPAIR).

(2) Secure clips on adapter (PWC31195) to interstage seal ring previously installed on the HP turbine stator shroud support (Ref. 72-50-01).

(3) Remove rear engine mount adapter (PWC31058), if installed.

(4) Mate assembled LPT stator support and combustion chamber liner assembly to gas generator case at Flange C, with fuel inlet and shut-off valve housing assembly at 6 o'clock position.

(5) Remove adapter (PWC31195).

(6) Secure LP turbine stator support assembly (1) to gas generator case as follows:

(a) For JT15D-5 (Pre-SB7249/Pre-SB7245/Post-SB7250/Pre-SB7324) engines: Use new bolts only. Install fifteen new bolts (10) with two washers under each bolt head. First bolt with washers must be installed in third hole from top dead center, and remaining bolts and washers in every fourth hole. Flats on washers should be on body of LP turbine stator support assembly (1).

(b) For JT15D-5 (Post-SB7245/Pre-SB7324) engines or JT15D-5 (Post-SB7249/Pre-SB7324) engines incorporating P/N MS9696-09 bolts: Use new bolts only. Install 45 new bolts (10) with first three bolts in third, fourth and fifth holes from top dead center position. Install remaining bolts in every fourth, fifth and sixth holes after.

(c) For Post-SB7249/Pre-SB7324 engines incorporating P/N 3111850-01 bolts: Use existing bolts. Install 45 existing bolts (10) with first three bolts in third, fourth and fifth holes from top dead center position. Install remaining bolts in every fourth hole.

(d) For JT15D-5 (Post-SB7324) and JT15D-5R engines: Use existing bolts. With top dead center hole as location No. 1, install first three bolts at fourth, fifth and sixth locations clockwise. Leave next five holes empty. Install three bolts at next three locations. Repeat this step for remaining thirteen sets of three bolts.

(7) Tighten all bolts gradually and progressively until resistance is felt to snap fit between LP turbine stator support and gas generator case.

NOTE: Do not exceed final torque (REF. NO. 1740, Table 201) during seating operation.

(8) Gradually and progressively, tighten bolts one half turn at a time and in a diametrically opposing (star) pattern until support is fully seated on gas generator case flange.

(9) Install spark igniters and tighten handtight (Ref. 74-20-02). If spark igniters do not fit, LP turbine stator support is not seated correctly. Remove and reinstall spark igniters and LP turbine stator support.

(10) Torque bolts in a star pattern (Ref. step (8) preceding) (REF. NO. 1740, Table 202) and remove clips installed at step (2), preceding.

(11) Install front inner bypass duct assembly (Ref. 72-70-01).

(12) Install rear engine mount (Ref. 72-70-04).

(13) Install primary and secondary fuel pressure tubes and associated fairing (Ref. 73-10-03).

(14) Install spark igniters and ignition cable coupling nuts (Ref. 74-20-02).

(15) Install LP turbine stator assembly and LP turbine rotor balancing assembly (Ref. 72-50-03).

(16) Install turbine exhaust duct and No. 4 bearing housing (Ref. 72-50-06).

(17) If a replacement or repaired combustion chamber liner or LP turbine stator support was installed, perform required ground checks (Ref. 71-00-00, ADJUSTMENT/TEST).

6. Inspection/Check

A. LP Turbine Stator Support Assembly - Wear and Fretting (Ref. Fig. 202)

(1) Inspect inner sealing ring contact circumference for wear (Ref. Fig. 202, Detail A). If wear limit is not met, return assembly to an approved overhaul facility for repair.

(2) Inspect nine narrow slots for fretting wear (Ref. Fig. 202, Detail B).

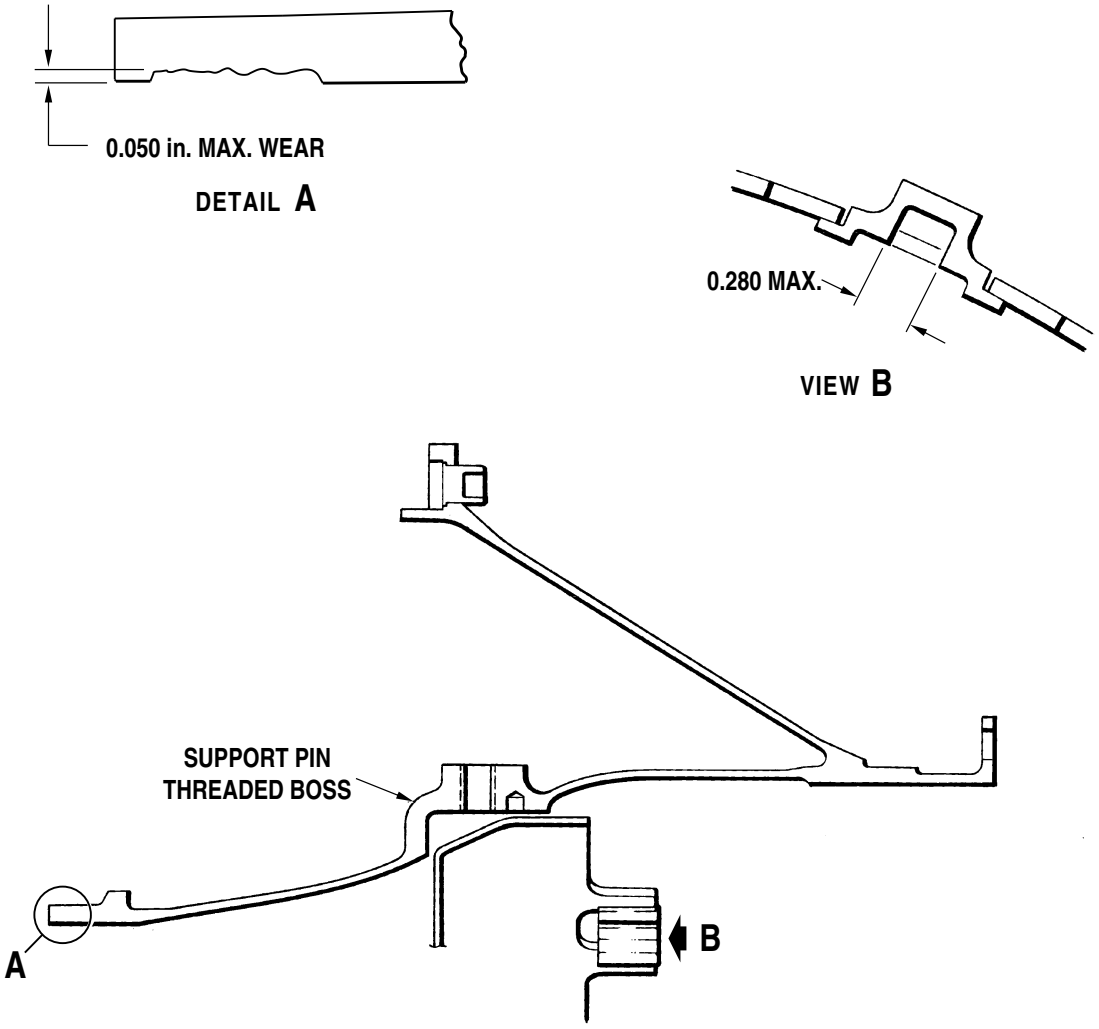
(a) Wear, up to a maximum slot width of 0.280 inch, is an acceptable condition, providing lateral movement of No.2 vane ring in LP turbine stator support does not exceed 0.016 inch in any direction.

(b) Return assembly to an approved overhaul facility, if preceding limits are exceeded.

(3) Inspect six support pin bosses for security and condition of threads.

B. Combustion Chamber Liner and Support Pins (Ref. Figs. 203 and 204)

(1) General



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Inspection/Check - LP Turbine Stator Support Assembly
Figure 202

(a) Problems most commonly affecting the combustion chamber liner are cracks, buckling and burning. These may occur separately or in combinations. Depending on the extent and location of the problem, the damage may be allowable without repair; repairable using local resources; or non-repairable, requiring rejection of the liner. Cracks in liner surfaces are usually caused by stress-relief and, if so, are not serious in that as a crack lengthens, its rate of growth diminishes. Typical liner distress consists of buckling and cracking of cooling rings, and cracking of the liner wall adjacent to the dome.

(2) Allowable Condition - Repair Not Required

(a) A maximum of seven cracks, each less than 1.5 inches in length are allowable without repair. Conditions in steps (b), (c) and (e)are subject to these limits.

(b) Straight line circumferential cracks between adjacent cooling holes.

(c) A maximum of three cracks in any one plane (each less than 1.5 inches long) in inner wrapper and adjacent to dome end. Cracks are allowable only if separated by at least three inches of sound metal.

(d) Localized areas of shallow buckling, provided there is no evidence of burning which would reduce wall thickness, and no abrupt change of contour (kinking) or cracks.

(e) Cracks in cooling rings are acceptable except as stated in step (4), following.

(f) Fretting wear of corrugated strips at open end of inner and outer liners up to 50 percent of thickness at any number of pads.

(g) Wear at hole in combustion chamber liner support boss (six places), provided that hole diameter is not greater than 0.260 inch.

(h) Wear to six combustion chamber liner support pins, provided that pin locating diameter Z is not less than 0.200 inch (Ref. Fig. 204). Check condition of threads.

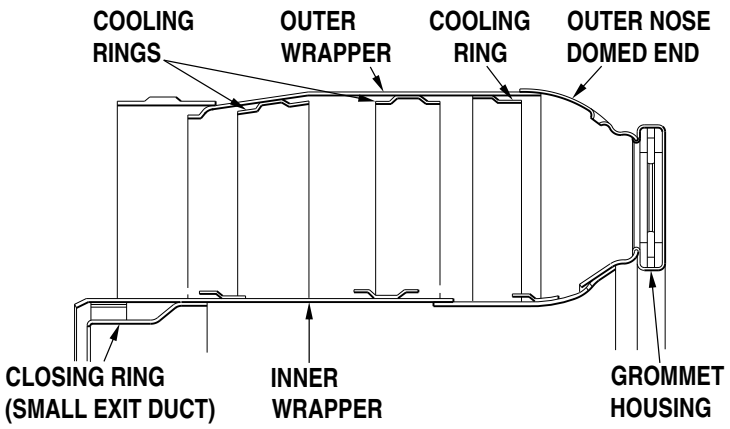
(3) Allowable Conditions - Repair Required

(a) Repair a maximum of three cracks only if each is separated by at least three inches of sound metal (Ref. Para. 7., Approved Repair). Conditions in steps (b) and (c)are subject to these limits.

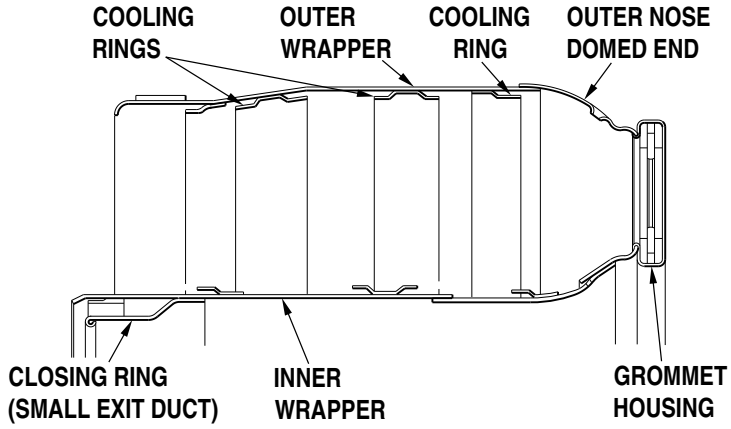
(b) Circumferential cracks in cooling ring seam welds which do not exceed 0.030 inch wide or 0.300 inch long (Ref. Para. 7.).

(c) Circumferential cracks adjacent to seam welds if not exceeding 0.030 inch wide and less than 1.500 inches long (Ref. Para. 7.).

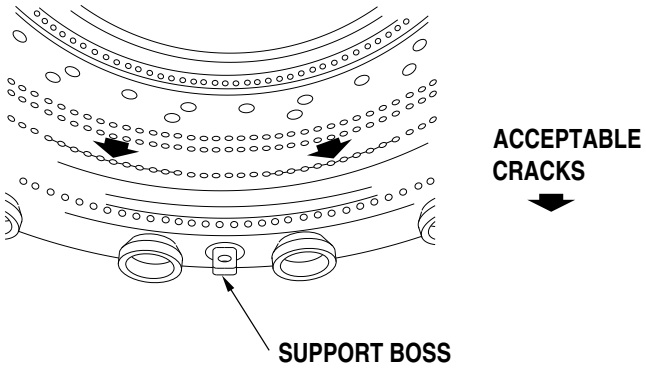
(d) Buckled cooling rings must be reworked using a suitable forming bar to restore a uniform gap.



JT15D–5 (REF. PD3133 / PRE–SB7360)



JT15D–5 (POST–SB7360) AND JT15D–5R



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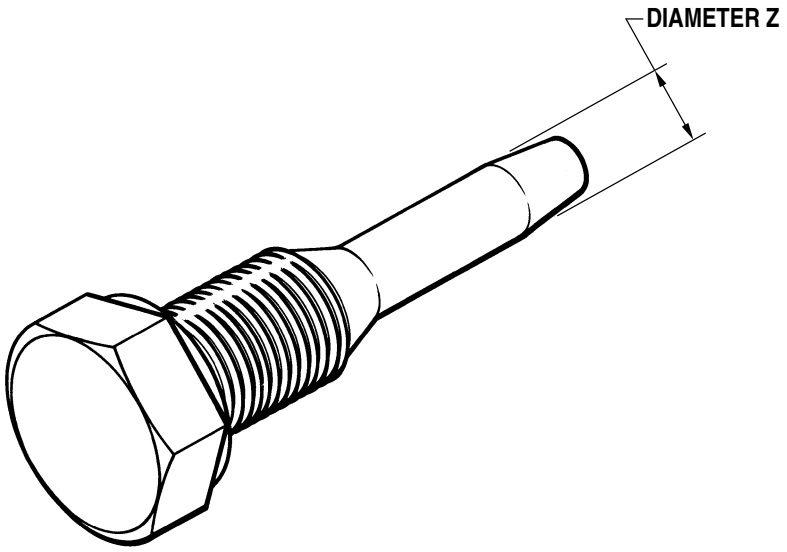
Inspection/Check - Combustion Chamber Liner
Figure 203 (Sheet 2)



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Inspection/Check - Combustion Chamber Liner Support Pin
Figure 204

(4) Unacceptable Conditions - Reject Combustion Chamber Liner

NOTE: Rejected combustion chamber liners removed during maintenance practices should be returned to an approved overhaul facility for possible restoration.

(a) Any crack exceeding 1.500 inches long.

(b) Cracks open more than 0.030 inch.

(c) Multiple cracks; cracks clustered in one area; branching cracks; cracks which might progress so as to meet and allow metal to break off.

(d) Severe buckling with abrupt change of contour (kinks); buckling associated with burning and resultant reduction of metal thickness.

(e) Any cracking or buckling in the combustion chamber dome; cracks in fuel nozzle adapter housings or igniter plug grommet housing.

(f) Wear at hole in combustion chamber liner support bosses, such that hole diameter is greater than 0.260 inch.

(g) Wear to combustion chamber liner support pins, such that pin locating diameter is less than 0.200 inch.

7. Approved Repairs

A. Crack Repair by Welding

(1) Stop-drill both ends of a crack using 1/16 (0.0625) inch drill. Wire brush to obtain bright metal.

(2) Weld crack using inert gas fusion method (Ref. 70-00-00, STANDARD PRACTICES - REPAIR) and filler rod (PWC05-151). Use copper back-up plate to reduce distortion, with recommended addition of Argon gas backup, if available. Stress relief after welding is not required.

(3) Dress excessive weld beads to meet "Nominal Weld" conditions specified in Chapter 70-00-00, STANDARD PRACTICES - INSPECTION.

B. Cooling Ring Repair

(1) Rework buckled cooling rings using a suitable forming bar to restore a uniform gap.

8. Fits, Clearances and Torque Loadings

A. Refer to Tables 201 and 202 and Figure 205.

TABLE 201, Fits and Clearances

REF. NO.	Name	Dim. for Ref. (inches) Min.	Dim. for Ref. (inches) Max.	Limits (inches) Min.	Limits (inches) Max.	Limits (inches) Replace
1075	Duct Assembly, Combustion Chamber Exit, Small	14.3160	14.3400	0.0050	0.0370 RADIAL	
	Liner Assembly, Combustion Chamber	14.3500	14.3900			
1077	Liner Assembly, Combustion Chamber	13.9400	13.9600	0.0000	0.0200 RADIAL	
	Duct Assembly, Combustion Chamber, Small	13.9600	13.9800			
1078	JT15D-5 (Pre-SB7545): Turbine Stator, HP	11.5880	11.5920	0.0150	0.0270 RADIAL	
	Duct, Combustion Chamber Exit, Small	11.6220	11.6420			
1078	JT15D-5 (Post-SB7545) and JT15D-5R: Turbine Stator, HP	11.5880	11.5920	0.0175	0.0295 RADIAL	
	Duct, Combustion Chamber Exit, Small	11.6270	11.6470			
1079	JT15D-5 (Pre-SB7545): Duct, Combustion Chamber Exit, Small	11.3000	11.3200	0.0080	0.0200 RADIAL	
	Turbine Stator, HP	11.3360	11.3400			
1079	JT15D-5 (Post-SB7545) and JT15D-5R: Duct, Combustion Chamber Exit, Small	11.2950	11.3150	0.0105	0.0225 RADIAL	
	Turbine Stator, HP	11.3360	11.3400			

TABLE 201, Fits and Clearances (Cont'd)

REF. NO.	Name	Dim. for Ref. (inches) Min.	Dim. for Ref. (inches) Max.	Limits (inches) Min.	Limits (inches) Max.	Limits (inches) Replace
1107	Case Assembly, Gas Generator	21.4790	21.4830	0.0000	0.0080T	
	Support Assembly, LP Turbine Stator	21.4750	21.4790			
1189	JT15D-5 (Pre-SB7432): Support, HPT Shroud Segments			0.0050 SIDE CLEARANCE	0.0160	
	Seal Ring, Interstage					
1189	JT15D-5 (Post-SB7432) and JT15D-5R: Support, HPT Shroud Segments			0.0040 SIDE CLEARANCE	0.0130	
	Seal Ring, Metal, High Pressure Stator					
1190	JT15D-5 (Pre-SB7432): Gap, Seal Ring (at 12.910 Gage Dia.)	0.1700	0.2000	0.1700	0.2250	
	Support, LP Turbine Stator, Assembly	12.9100	12.9180			
1190	JT15D-5 (Post-SB7432) and JT15D-5R: Gap, Seal Ring (at 12.910 Gage Dia.)	0.0850	0.1150	0.0850	0.1270	
	Support, LP Turbine Stator, Assembly	12.9100	12.9140			

TABLE 202, Torque and Stretch

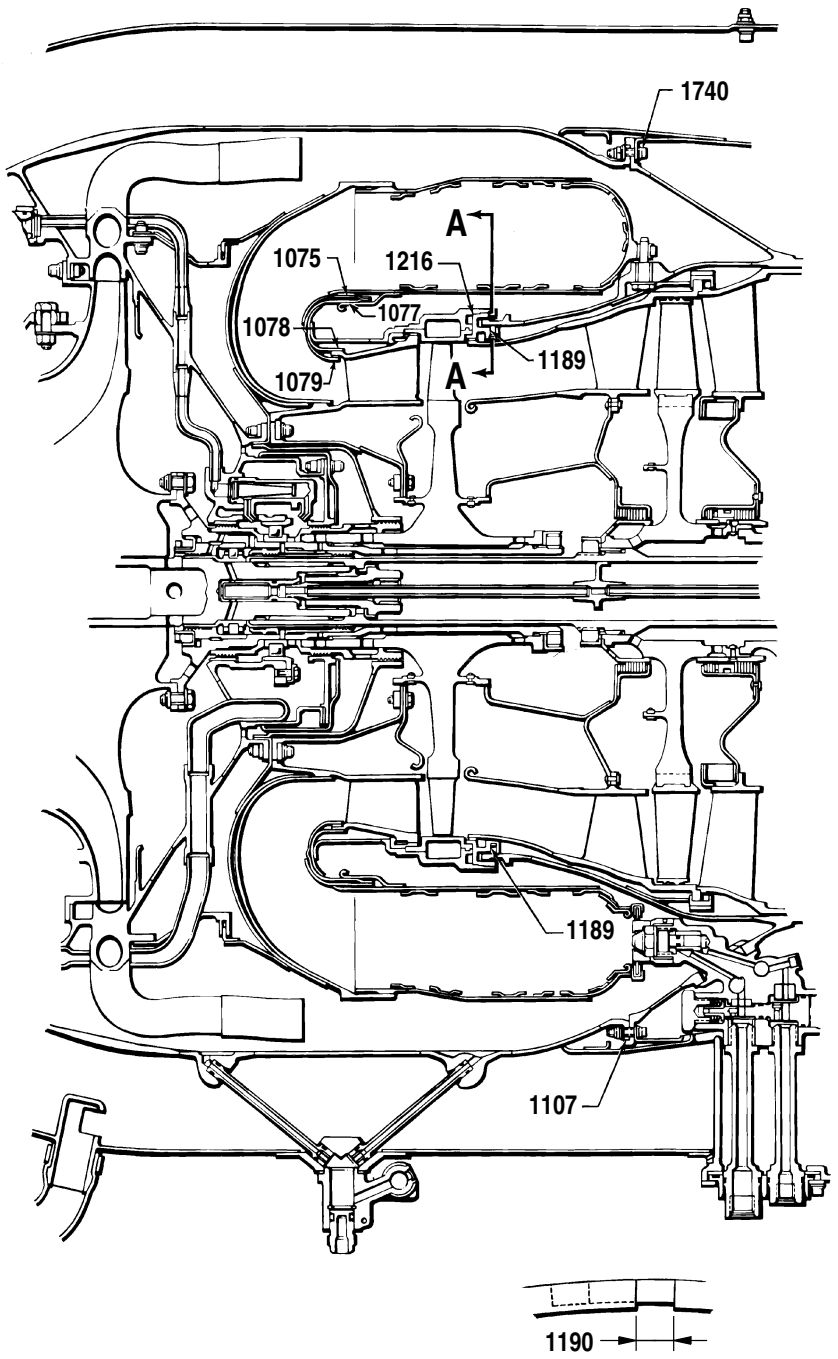
REF. NO.	Name	Limits Min.	Limits Max.
1740	Bolts, Gas Generator Case, LP Turbine Stator Support Flange Assembly	46 lb.in.	52 lb.in.

TABLE 203, Spring Pressure

REF. NO.	Name	Limits Min.	Limits Max.
	Not Applicable		

TABLE 204, Special Assembly

REF. NO.	Name	Limits Min.	Limits Max.
	Not Applicable		



SECTION A–A

JT15D-5 SHOWN (JT15D-5R SIMILAR)

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Fits, Clearances and Torque Loadings
Figure 205

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
LEP	1	May 13/2013
	2	May 13/2013
	3	May 13/2013
	4 blank	May 13/2013
Contents	1	May 13/2013
	2	May 13/2013
	3	May 13/2013
	4	May 13/2013
	5	May 13/2013
	6 blank	May 13/2013
72-50-00	1	Oct 06/2006
Description and	2	Oct 06/2006
Operation	3	Oct 06/2006
	4 blank	Oct 06/2006
72-50-01	1	Oct 06/2006
Description and	2	Oct 06/2006
Operation	3	Oct 06/2006
	4	Oct 06/2006
72-50-01	201	May 13/2013
Maintenance	202	May 13/2013
Practices	203	May 13/2013
	204	May 13/2013
	205	May 13/2013
	206	May 13/2013
	207	May 13/2013
	208	May 13/2013
	209	May 13/2013
	210	May 13/2013
	211	May 13/2013
	212	May 13/2013
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	237	May 13/2013
	238	May 13/2013
	239	May 13/2013
	240	May 13/2013
	241	May 13/2013
	242 blank	May 13/2013
72-50-02	1	Oct 06/2006
Description and	2	Oct 06/2006
Operation	3 deleted	
	4 deleted	
72-50-02	201	Feb 18/2011
Maintenance	202	Feb 18/2011
Practices	203	Feb 18/2011
	204	Feb 18/2011
	205	Feb 18/2011
	206	Feb 18/2011
	207	Feb 18/2011
	208	Feb 18/2011
	209	Feb 18/2011
	210	Feb 18/2011
	211	Feb 18/2011
	212	Feb 18/2011

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
	213	Feb 18/2011
	214	Feb 18/2011
	215	Feb 18/2011
	216	Feb 18/2011
	217	Feb 18/2011
	218	Feb 18/2011
	219	Feb 18/2011
	220	Feb 18/2011
	221	Feb 18/2011
	222	Feb 18/2011
	223	Feb 18/2011
	224	Feb 18/2011
	225	Feb 18/2011
	226 blank	Feb 18/2011
72-50-03	1	Oct 06/2006
Description and	2	Oct 06/2006
Operation	3	Oct 06/2006
	4 blank	Oct 06/2006
72-50-03	201	May 13/2013
Maintenance	202	May 13/2013
Practices	203	May 13/2013
	204	May 13/2013
	205	May 13/2013
	206	May 13/2013
	207	May 13/2013
	208	May 13/2013
	209	May 13/2013
	210	May 13/2013
	211	May 13/2013
	212	May 13/2013
	213	May 13/2013
	214	May 13/2013
	215	May 13/2013
	216	May 13/2013
	217	May 13/2013
	218	May 13/2013
	219	May 13/2013
	220	May 13/2013
	221	May 13/2013

CHAPTER SECTION	PAGE	DATE
	222	May 13/2013
72-50-04	1	Oct 22/99
Description and	2	Oct 22/99
Operation		
72-50-04	201	May 13/2013
Maintenance	202	May 13/2013
Practices	203	May 13/2013
	204	May 13/2013
	205	May 13/2013
	206 blank	May 13/2013
72-50-05	1	May 13/2013
Description and	2 blank	May 13/2013
Operation		
72-50-06	1	Oct 22/99
Description and	2	Oct 22/99
Operation		
72-50-06	101	Oct 22/99
Fault Isolation	102 blank	Oct 22/99
72-50-06	201	May 13/2013
Maintenance	202	May 13/2013
Practices	203	May 13/2013
	204	May 13/2013
	205	May 13/2013
	206	May 13/2013
	207	May 13/2013
	208	May 13/2013
	209	May 13/2013
	210	May 13/2013
	211	May 13/2013
	212	May 13/2013
	213	May 13/2013
	214	May 13/2013
	215	May 13/2013
	216	May 13/2013
	217	May 13/2013

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
	218	May 13/2013
	219	May 13/2013
	220	May 13/2013
	221	May 13/2013
	222	May 13/2013
	223	May 13/2013
	224	May 13/2013
	225	May 13/2013
	226	May 13/2013
	227	May 13/2013
	228	May 13/2013
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	246	May 13/2013
	247	May 13/2013
	248	May 13/2013
	249	May 13/2013
	250	May 13/2013
	251	May 13/2013
	252	May 13/2013
	253	May 13/2013
	254 blank	May 13/2013

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
TURBINE SECTION - DESCRIPTION AND OPERATION	**72-50-00**
1. High Pressure and Low Pressure Turbines	1
HPT STATOR, EXIT DUCTS - DESCRIPTION AND OPERATION	**72-50-01**
1. Description	1
A. HP Turbine Stator Assembly	1
B. Large and Small Exit Ducts	1
C. HP Turbine Air Seal	1
HPT STATOR, EXIT DUCTS - MAINTENANCE PRACTICES	**72-50-01**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	202
5. Removal/Installation (Heavy Maintenance Only)	202
A. Removal of HP Turbine Stator Assembly, Large and Small Exit Ducts	202
B. Installation of HP Turbine Stator Assembly, Large and Small Exit Ducts	209
6. Inspection/Check	213
A. Interstage Seal Ring	213
B. High Pressure Turbine Air Seal and Baffle	213
C. Shroud Segments	213
D. Small Exit Duct	214
E. HP Turbine Stator Sealing Ring	221
F. High Pressure Turbine Stator Assembly	221
G. Large Exit Duct	226
7. Approved Repairs	226
A. HP Turbine Stator Assembly - Repairability Criteria	226

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
HPT STATOR, EXIT DUCTS - MAINTENANCE PRACTICES (Cont'd)	**72-50-01**
B. HP Turbine Shroud Segments - Repair by Replacement	228
C. Grinding of HP Turbine Shroud Segments	229
8. Fits, Clearances and Torque Loadings	236
HP TURBINE DISK BALANCING ASSEMBLY - DESCRIPTION AND OPERATION	**72-50-02**
1. Description	1
HP TURBINE ASSEMBLY - MAINTENANCE PRACTICES	**72-50-02**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	202
5. Removal/Installation (Heavy Maintenance Only)	202
A. Removal of HP Turbine Disk Assembly	202
B. Installation of HP Turbine Disk Assembly	209
6. Procedure for Installing Replacement High Pressure Turbine	212
A. Establish Trim Balance Weight Configuration for Replacement Turbine	212
B. Determine HP Turbine Positioning Spacer Dimension as follows :	214
C. Installation Procedure	214
7. Inspection/Check	214
A. Procedure	214
8. Approved Repairs (Heavy Maintenance Only)	218
A. Procedure	218
9. Fits, Clearances and Torque Loadings	218

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
LP TURBINE ROTOR BALANCING ASSEMBLY - DESCRIPTION AND OPERATION	**72-50-03**
1. Description	1
LP TURBINE ROTOR - MAINTENANCE PRACTICES	**72-50-03**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	202
5. Removal/Installation (Heavy Maintenance Only)	202
A. Removal of LP Turbine Rotor Balancing and LP Turbine Stator Assemblies	202
B. Installation of LP Turbine Rotor Balancing Assembly and LP Turbine Stator Assembly	207
6. Inspection/Check	210
A. Low Pressure Turbine Rotor Balancing Assembly	210
B. LP Turbine Shaft	215
C. Intershaft Oil Transfer Tube	215
7. Cleaning/Painting	218
A. Intershaft Oil Transfer Tube Assembly	218
B. Low Pressure Turbine Shaft	219
8. Fits, Clearances and Torque Loadings	219
SECOND-STAGE LPT STATOR - DESCRIPTION AND OPERATION	**72-50-04**
1. Description)	1
SECOND-STAGE LPT STATOR - MAINTENANCE PRACTICES	**72-50-04**
1. General	201
2. Consumable Materials	201
3. Special Tools	201

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
SECOND-STAGE LPT STATOR - MAINTENANCE PRACTICES (Cont'd)	**72-50-04**
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation (Heavy Maintenance Only)	201
6. Inspection/Check	201
A. Procedure	201
7. Fits, Clearances and Torque Loadings	204
THIRD-STAGE LP TURBINE STATOR- DESCRIPTION AND OPERATION	**72-50-05**
1. General	1
EXHAUST DUCT, NO. 4 BEARING HOUSING - DESCRIPTION AND OPERATION	**72-50-06**
1. Exhaust Duct)	1
ENGINE CONTROLS - FAULT ISOLATION	**72-50-06**
1. Fault Isolation	101
EXHAUST DUCT ASSEMBLY - MAINTENANCE PRACTICES	**72-50-06**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation (Heavy Maintenance Only)	201
A. Removal of Turbine Exhaust Duct	201
B. Installation of Turbine Exhaust Duct	202
C. Removal of No. 4 Bearing Housing and Cover Assembly	208
D. Installation of No. 4 Bearing Housing and Cover Assembly	208
E. Removal of Emergency Fuel Shutoff Valve Control Linkage	214
F. Installation of Emergency Fuel Shutoff Valve Control Linkage	223

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
EXHAUST DUCT ASSEMBLY - MAINTENANCE PRACTICES (Cont'd)	**72-50-06**
G. Disassembly of No. 4 Bearing Housing and Cover	229
H. Assembly of No. 4 Bearing Housing and Cover	230
6. Inspection/Check	232
A. Exhaust Duct	232
B. Exhaust Duct Borescope Plug Lockwire Tab	232
C. No. 4 Bearing Housing	233
D. No. 4 Bearing Housing Cover Assembly	233
E. No. 4 Bearing Housing/Exhaust Duct Lug Mating Faces	236
F. Exhaust Duct T6 Thermocouple Installation	236
G. No. 4 Bearing Oil Nozzle Strainer Element	236
H. Actuating Rod	236
7. Cleaning and Painting	238
A. No. 4 Bearing Housing	238
B. No. 4 Bearing Housing Cover	239
C. No. 4 Bearing Oil Nozzle Strainer Element	240
D. Actuating Rod	240
8. Approved Repairs	240
A. Exhaust Duct - Cracks	240
B. Exhaust Duct - Repair for Borescope Plug Lockwire Tab by Replacement	241
C. No. 4 Bearing Carbon Seal - Repair by Replacement	241
9. Fits, Clearances and Torque Loadings	243

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TURBINE SECTION - DESCRIPTION AND OPERATION

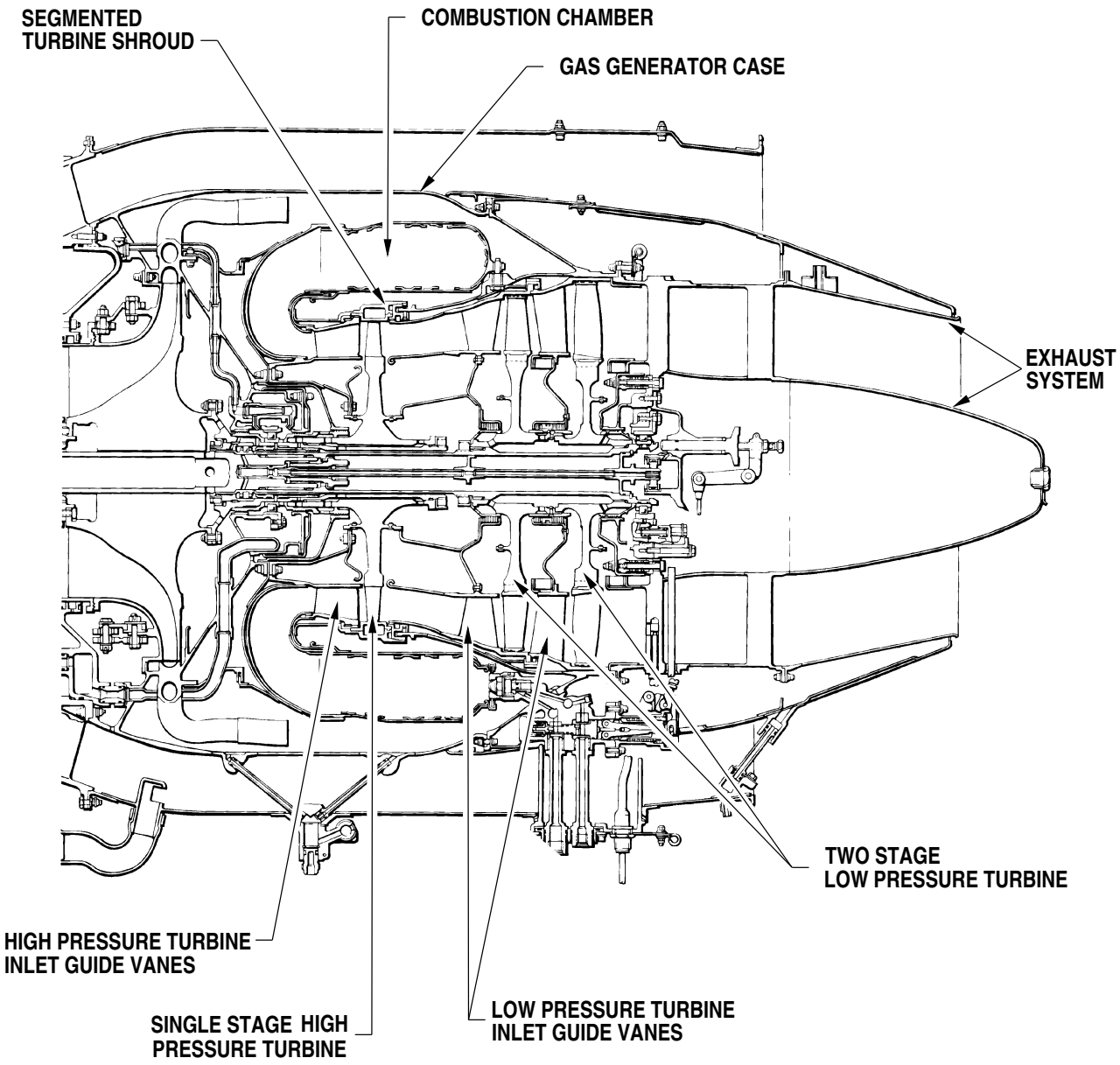
1. High Pressure and Low Pressure Turbines (Ref. Fig. 1)

   The engine incorporates a single-stage HP turbine and a two-stage LP turbine, both arranged as a two-spool concentric shaft system. The LP turbine drives the LP compressor through a common inner shaft and the HP turbine drives the HP impeller via the outer shaft.

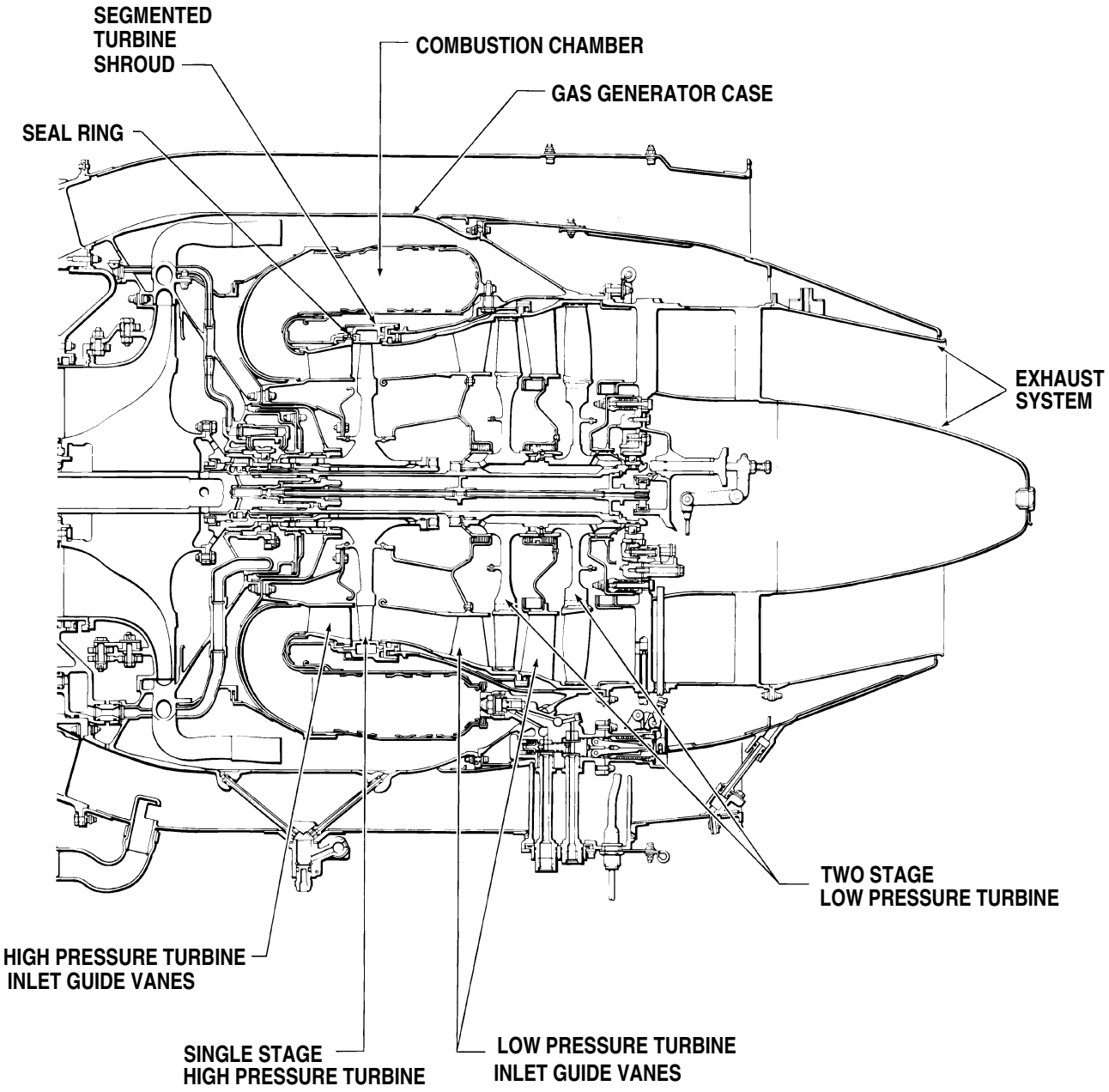
   Each turbine stage is preceded by an inlet guide vane assembly which directs the gas flow to the turbine blades at an angle which ensures the turbines are driven with maximum efficiency. The turbine disk faces and the high pressure inlet guide vanes are air-cooled by HP compressor (P3) discharge air.

   The HP turbine rotates within a segmented shroud assembly. The HP turbine blades, together with the preceding inlet guide vanes, locate at the combustion chamber exit in the gas generator case. The low pressure two-stage turbine assembly is positioned immediately to the rear of the HP turbine.

   The gas flow from the combustion chamber is directed to, and expands through, the HP turbine, to rotate the HP rotating assembly. The discharged gases next expand through the two-stage LP turbine, to rotate the LP rotating assembly, then are vented to the atmosphere through the exhaust system.



Turbine Section (Typical)
Figure 1 (Sheet 1 of 2)



JT15D–5 (POST–SB7273) SHOWN
JT15D–5R SIMILAR

C18893B

Turbine Section (Typical)
Figure 1 (Sheet 2)

HPT STATOR, EXIT DUCTS - DESCRIPTION AND OPERATION

1. Description

A. HP Turbine Stator Assembly

The high pressure turbine stator assembly consists of an integrally cast cobalt alloy vane ring with 14 vanes located between the combustion chamber exit ducts and the high pressure turbine (Ref. Figs.1 and 2). The vanes ensure that the expanding gases are directed to the high pressure turbine blades at the optimum angle to drive the turbine. The outer platform has 14 lugs extended radially outward to locate in slots machined in the inner exit duct assembly. The inner platform is extended forward and has 12 lugs extended radially inward by which the high pressure turbine stator assembly is mounted to the gas generator case. The vanes are cooled using compressor delivery (P3) air which is passed through the vanes to exit into the gas path through holes in the trailing edges.

B. Large and Small Exit Ducts

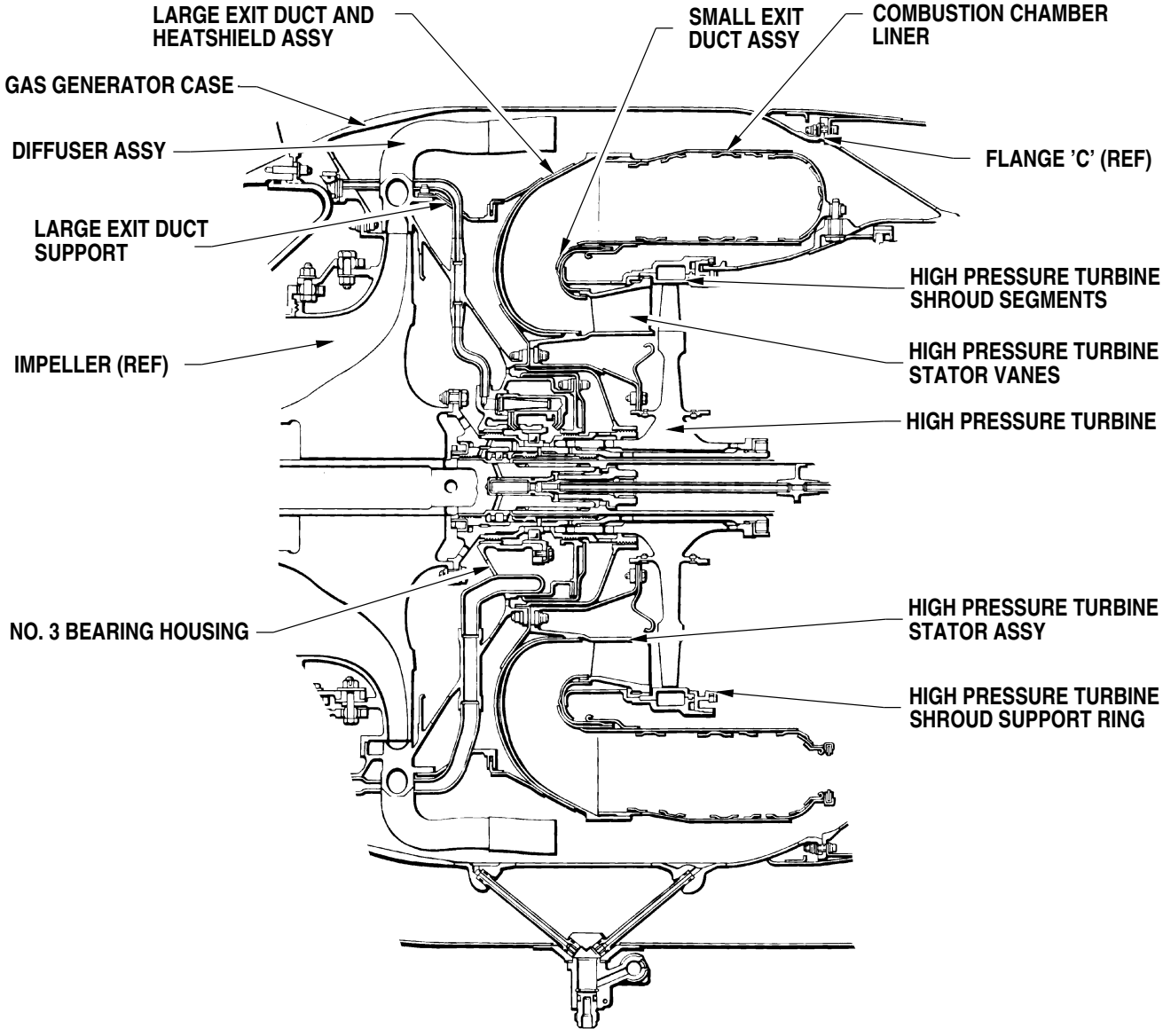
When installed, the large and small exit ducts are designed to reverse the gas flow from the combustion chamber and direct it to the high pressure turbine stator vanes (Ref. Figs.1 and 2). Four support brackets welded to the convex surface of the large exit duct, engage with a slotted support ring bolted to the diffuser assembly of the gas generator case, and restrain the duct axially. The center section of the large exit duct assembly is bolted with the high pressure turbine stator assembly to the No.3 bearing housing.The heat shield forms a cavity which is allowed to breathe with changing temperature.

The small exit duct assembly assists the large exit duct assembly in diverting the gas flow to the high pressure turbine stator vanes. It consists of an overlapping sheet metal assembly with an enlarged flange at the rear which forms the housing for the high pressure turbine stator assembly and the high pressure turbine shroud segments. A shroud support ring is riveted to this housing and has an annular groove that supports an interstage sealing ring. The space provided by the sheet metal overlap allows the passage of cooling air through the duct.

I JT15D-5 (Post-SB7273) and JT15D-5R engines incorporate a metal sealing ring installed between the HP turbine stator and small exit duct, to prevent gas flow leakage.

C. HP Turbine Air Seal

The double-walled high pressure turbine air seal assembly (Ref. Figs.1 and 2) is a nickel alloy weldment, the inner wall of which supports the No.3 bearing rear downstream seal stator. A recessed front flange around the assembly outer wall includes 12 slots for the mounting lugs of the high pressure turbine stator assembly, and 24 holes for bolting to the gas generator case weldment. The cone shaped rear end of the outer wall terminates in an inward projection which forms the high pressure turbine air seal. The high pressure turbine baffle is a nickel alloy ring with a rolled outer edge. Around its inner circumference, six holes grouped in pairs provide for connection to the air seal by means of double-threaded plate nuts, double keywashers and bolts.



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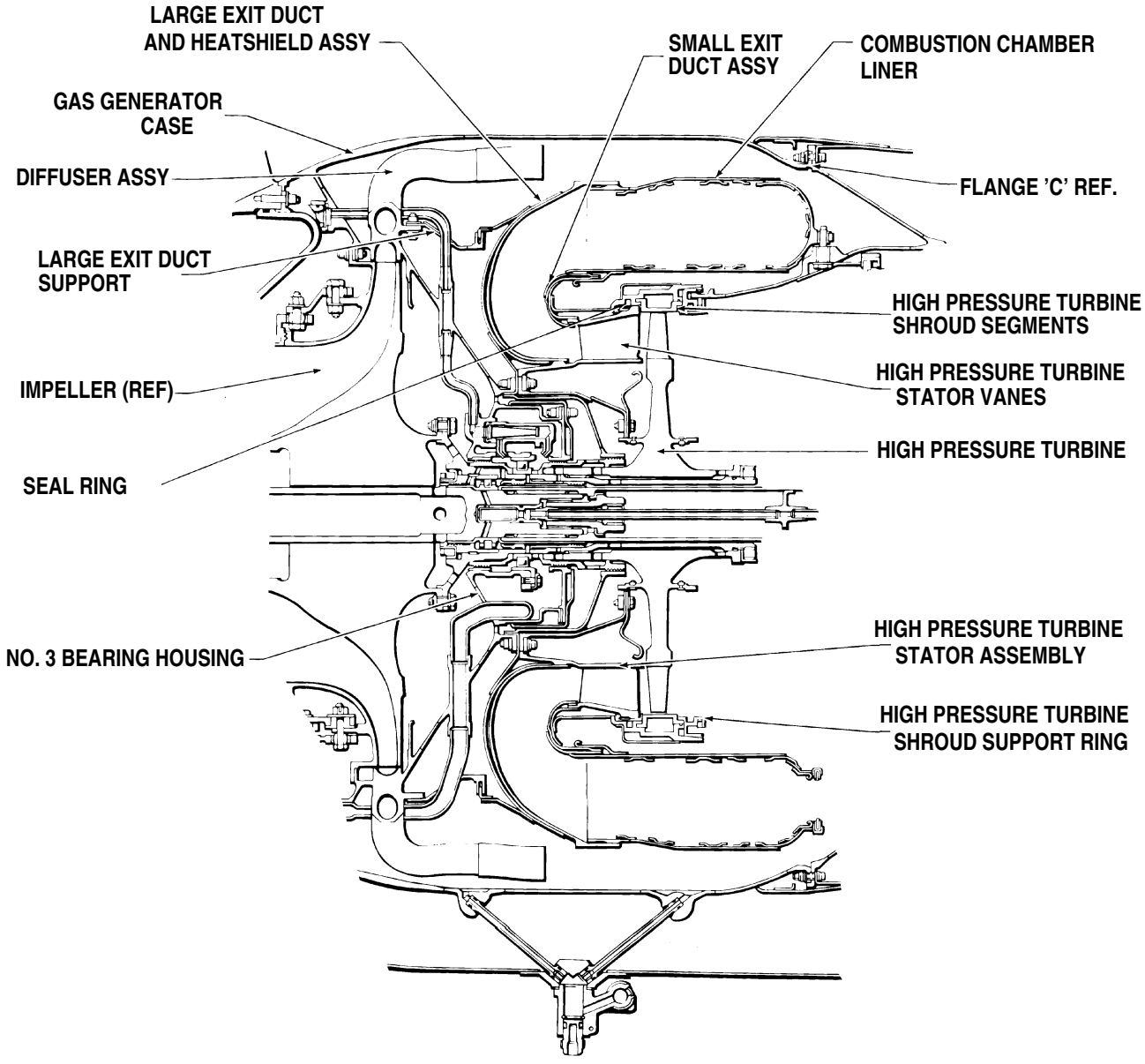
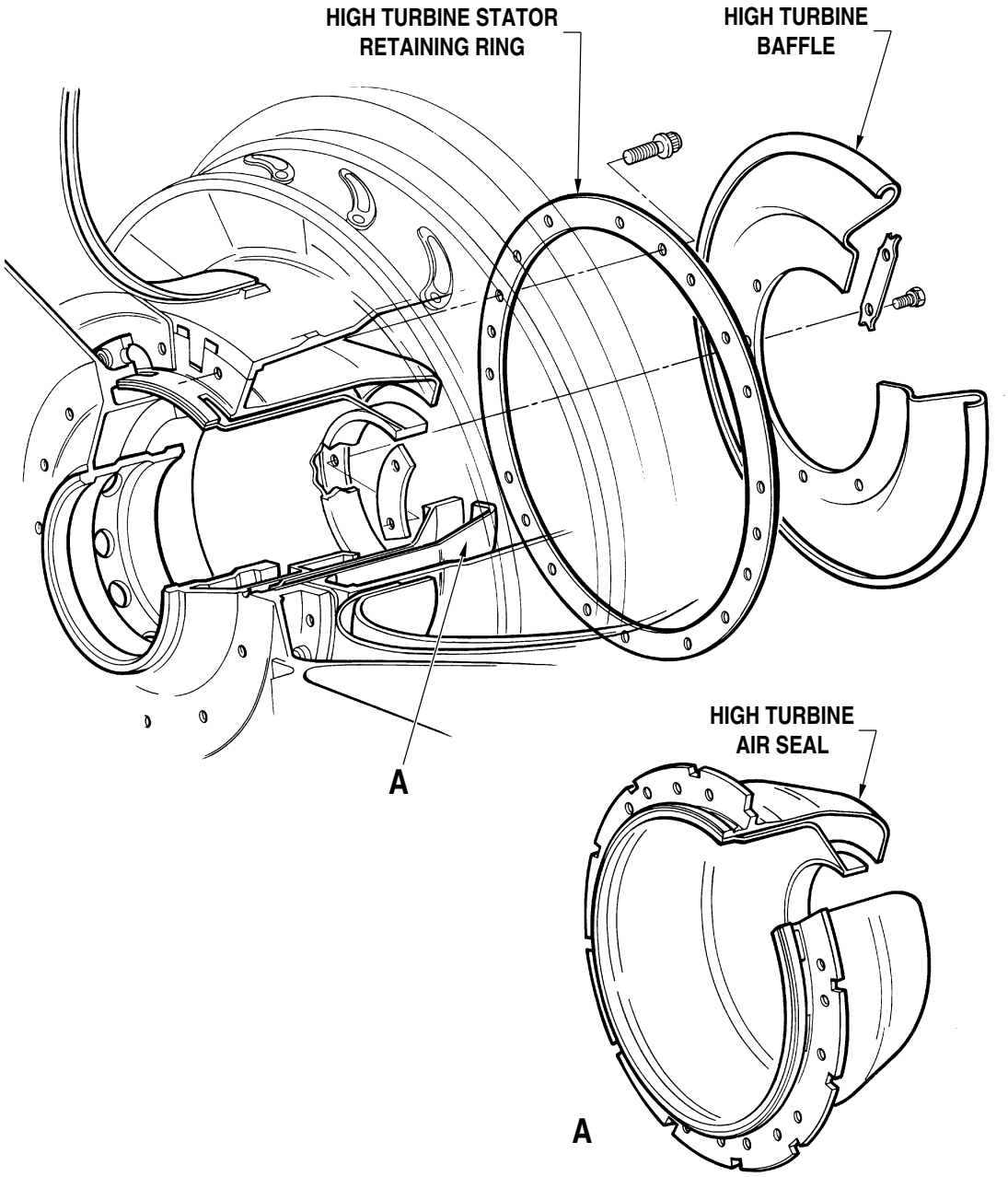
High Pressure Turbine Stator, Large and Small Exit Ducts
Figure 1 (Sheet 1 of 2)



JT15D–5 (POST–SB7273) SHOWN
JT15D–5R SIMILAR

C18948B

High Pressure Turbine Stator, Large and Small Exit Ducts
Figure 1 (Sheet 2)



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High Pressure Turbine Air Seal and Baffle Assembly
Figure 2

HPT STATOR, EXIT DUCTS - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the HP turbine stator, the large and small exit ducts, and related components.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC05-018	Metal Marking Crayon
PWC11-027	Petroleum Solvent

3. Special Tools

   The special tools listed below are used in the following procedures.

Tool No.	Name	Application
PWC31035	Socket, HP Turbine Retaining Nut	Used with PWC31050 wrench
PWC31068	Shroud Grinding Fixture	Replaced by PWC31668
PWC31071	Riveter, HPT Shroud Retaining Ring	
PWC31079	Puller, HPT Shroud Retaining Ring	
PWC31083	Radius Gage	Replaced by PWC31883
PWC31084	Spacer, HPT Shroud Grinding	
PWC31195	Adapter (Clips), Sealing Ring	
PWC31511	Blanking Plug	
PWC31512	Blanking Cap	
PWC31656	Puller, HP Turbine Air Seal	
PWC31668	Shroud Grinding Fixture	
PWC31669	Grinding Wheel	Use with PWC31668
PWC31670	Grinding Wheel Dresser	
PWC31683	Radius Gage, HPT Shroud Segments Grinding	
PWC31835	Socket, HP Turbine Retaining Nut	Used with PWC41050 wrench

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The export control classification with respect to this document is contained on the back of the title page.

Tool No.	Name	Application
PWC31685	Adapter	Used with PWC31068 and PWC31083: replaced by PWC31885
PWC31885	Adapter	Used with PWC31668 and PWC310883
PWC32122-52	Grinding Wheel	Used with PWC31068

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Removal/Installation (Heavy Maintenance Only)

A. Removal of HP Turbine Stator Assembly, Large and Small Exit Ducts (Ref. Figs. 201 and 202)

(1) Remove turbine exhaust duct and No.4 bearing housing assembly (Ref. 72-50-06).

(2) Remove LP turbine rotor balancing assembly (Ref. 72-50-03).

(3) Remove second-stage LP turbine stator assembly (Ref. 72-50-04).

(4) Remove LP turbine stator support assembly with fuel manifold system and combustion liner installed (Ref. 72-40-01).

(5) Remove interstage sealing ring ((1), Fig. 201).

(6) Remove HP turbine assembly (Ref. 72-50-02). From tip clearances measured at removal of HP turbine, determine if shroud segment requires grinding or replacement.

(a) If tip clearances are acceptable, proceed to step (7).

(b) If not acceptable, note segment(s) requiring grinding or replacement. Calculate length of longest HP turbine disk radius as follows (Ref. Fig. 202):

NOTE: This dimension is required for replacement or grinding of shroud segments (Ref. Para.7.).

1 With spacers (PWC31084) (2) between small exit duct (SED) (1) and large exit duct (LED) (3), load SED in running position.

2 Install adapter (7) on HP turbine shaft (9) and secure with HP turbine shaft locking nut (6).

3 Tighten nut (6) handtight using socket (PWC31035) or (PWC31835) to ensure adapter (7) is seated on HP turbine positioning spacer.

4 Remove radius gage assembly (5) from calibrating block. Secure radius gage (PWC31083) to adapter (7) with four bolts (4). Secure radius gage (PWC31683) to adapter (7) with three bolts (4).

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5 Rotate radius gage (5) and take a deflection reading at center of shroud segment located closest to 6 o'clock position.

6 Calculate and record length of longest disk radius as follows:

a Dimension A: add step 5 deflection reading to dimension marked on radius gage (PWC31083) or (PWC31683)calibrating block.

b Dimension B: tip clearance of longest disk radius measured and recorded at center of shroud segment closest to 6 o'clock position (Ref. 72-50-02).

Dimension A - Dimension B = length of longest disk radius.

7 Remove radius gage (5) and adapter (7). Remove spacers (2).

(7) Unstake three double keywashers ((8), Fig. 201) and remove six bolts (2) and three multiple plain nuts (7) securing HP turbine baffle (4). Remove baffle.

(8) Remove 24 bolts (3) and retaining ring (5).

(9) Remove HP turbine stator/small exit duct assembly and HP turbine air seal as follows:

NOTE: 1. The tight fit between the HP turbine air seal (6) and the gas generator case normally results in the air seal remaining in the engine when the HP turbine stator (11) and small exit duct (13) are removed as an assembly.

NOTE: 2. The tight fit between the HP turbine air seal (6) slots and the HP turbine stator (11) lugs may require removing the air seal with the assembled stator and small exit duct assembly.

(a) Remove assembled HP turbine stator (11) and small exit duct (13) by hand. If resistance is encountered, proceed to step (b).

(b) Remove blanking cap (PWC31512) and blanking plug (PWC31511). Install puller (PWC31656) on HP turbine air seal (6).

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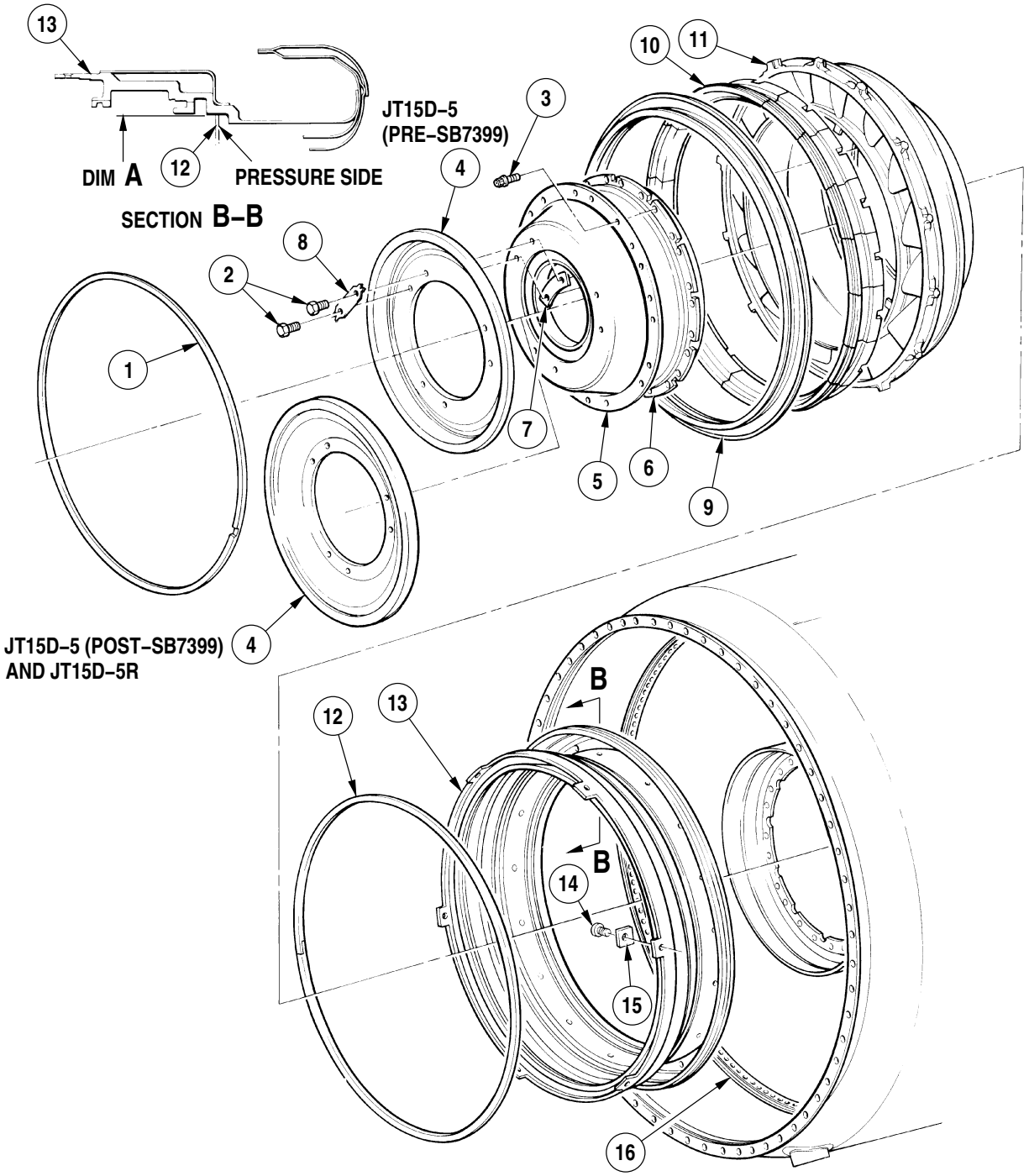
The export control classification with respect to this document is contained on the back of the title page.



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Removal/Installation - HP Turbine Stator Assembly, Large and Small Exit Ducts
Figure 201

Key to Figure 201

1. Interstage Seal Ring
2. Bolt
3. Bolt
4. HP Turbine Baffle
5. Retaining Ring
6. HP Turbine Air Seal Assembly
7. Multiple Plain Nut
8. Double Keywasher
9. HP Turbine Shroud Support Ring
10. HP Turbine Shroud Segment
11. HP Turbine Stator Assembly
12. HP Turbine Stator Seal Ring
12. HP Turbine Stator Seal Ring, JT15D-5 (Post-SB7273) and JT15D-5R
13. Small Exit Duct Assembly
14. Rivet
15. Retaining Plate
16. Large Exit Duct Assembly

CAUTION: DO NOT REMOVE HP TURBINE AIR SEAL FROM ASSEMBLED HP TURBINE STATOR ASSEMBLY/SMALL EXIT DUCT. IT MAY NOT BE POSSIBLE TO REASSEMBLE THESE TWO COMPONENTS BECAUSE OF INCREASED TIGHT FIT BETWEEN AIR SEAL SLOTS AND STATOR LUGS CAUSED BY OPERATING CONDITIONS. AIR SEAL AND STATOR MAY BE INSPECTED IN SITU.

CAUTION: INSTALL BLANKING CAP (PWC31512) AFTER HP TURBINE AIR SEAL HAS BEEN REMOVED.

(c) Operate puller and remove HP turbine air seal (6), or HP turbine stator (11), small exit duct (13) and HP turbine air seal, as an assembly.

NOTE: If HP turbine air seal separates from HP turbine stator/small exit duct assembly during use of puller, handle components with care.

(d) Remove puller (PWC31656) and reinstall blanking plug (PWC31511) in HP turbine shaft, and blanking cap (PWC31512) in No. 3 bearing air seal.

(10) If required, separate HP turbine stator (11) from small exit duct (13) as follows:

NOTE: Remove shroud segments from small exit duct (SED) only when required. Full separation of the SED assembly is only required at HSI, when shroud retaining ring, HPT stator or SED are damaged, or when numerous shroud segments are damaged.

(a) Remove six tubular countersunk rivets (14) by punching out rivet shanks using a suitable diameter punch. Remove six retaining plates (15) with rivets.

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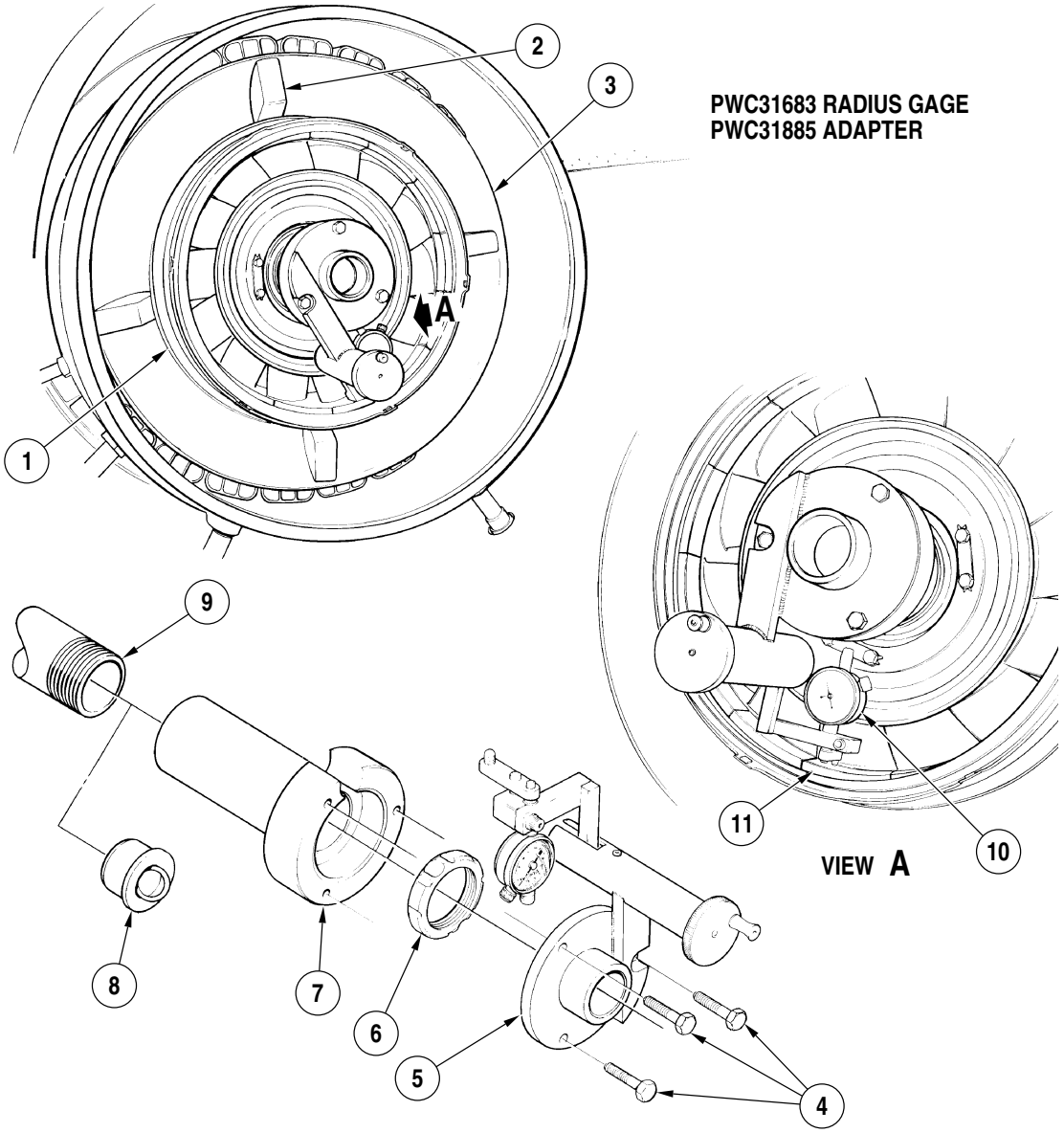

C22914A

Calculation of Longest HP Turbine Disk and Shroud Segment Radii
Figure 202 (Sheet 1 of 2)

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Key to Figure 202

1. Small Exit Duct
2. Spacer (PWC31084), 4 required
3. Large Exit Duct
4. Bolt
5. Radius Gage
6. HP Turbine Shaft Locking Nut
7. Adapter
8. Blanking Plug (PWC31511)
9. HP Turbine Shaft
10. Dial Test Indicator
11. Shroud Segment

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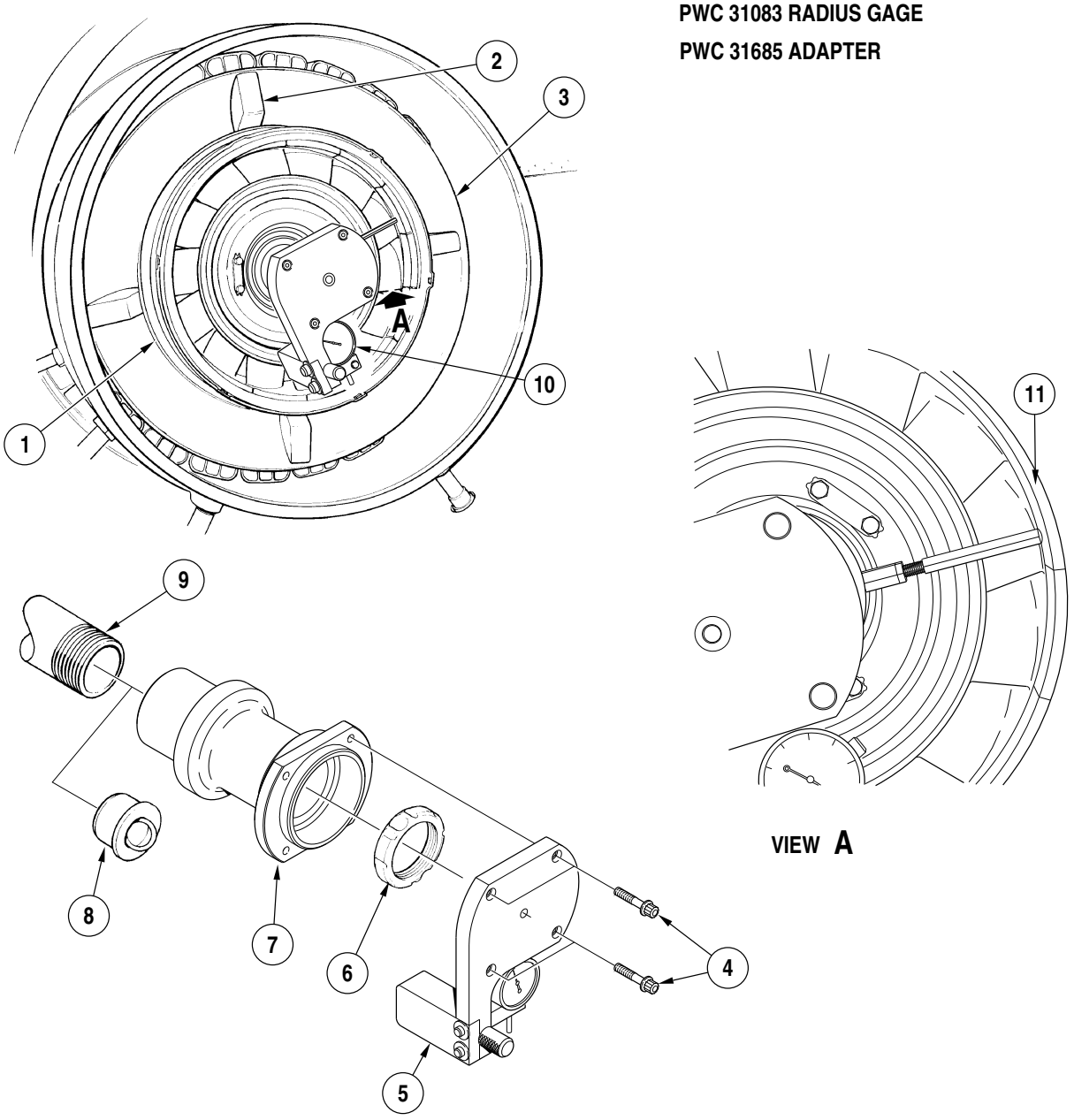

C38777A

Calculation of Longest HP Turbine Disk and Shroud Segment Radii
Figure 202 (Sheet 2)

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(b) Remove HP turbine shroud support (9) using puller (PWC31079).

(c) Remove 14 HP turbine shroud segments (10), recording class and position.

NOTE: If HP turbine stator requires replacement, refer to 72-50-02.

(d) Separate HP turbine stator assembly (11) from small exit duct assembly (13). For JT15D-5 (Post-SB7273) and JT15D-5R engines, remove seal ring (12) from HP turbine stator assembly. Mark forward side of seal ring 'PRESSURE SIDE' to identify for subsequent reassembly using metal marking crayon (PWC05-018).

(11) Mark large exit duct assembly (16) at 12 o'clock position for reference at reassembly using metal marking crayon (PWC05-018) before removal.

(12) Disengage duct from gas generator case by rotating it either way approximately 45 degrees, then remove.

(13) Inspect HP turbine air seal (6) separately or while installed in HP turbine stator (11), and other components (Ref. Para. 6.).

B. Installation of HP Turbine Stator Assembly, Large and Small Exit Ducts (Ref. Figs. 201 and 203)

CAUTION: IF REPLACEMENT HP TURBINE STATOR ASSEMBLY IS INSTALLED, HP TURBINE POSITIONING SPACER DIMENSIONING PROCEDURES MUST BE PERFORMED (REF. 72-50-02).

(1) Freeze HP turbine shroud support ((9), Fig. 201) for 20 minutes minimum at -40°C (-40°F).

(2) Align index marks on HP turbine stator assembly (11) and small exit duct assembly (13), and insert stator assembly into duct assembly.

(3) If a replacement HP turbine stator (11) is to be installed, or if index marks cannot be located, proceed as follows:

(a) Install HP turbine stator (11) into small exit duct assembly (13).

(b) Rotate HP turbine stator assembly (11) so that one side of at least one lug is butted against side of slot in small exit duct assembly (13).

(c) Check that a 0.001 inch feeler gage can be inserted in gap at clearance side of all lugs (Ref. Fig. 203).

(d) If clearance is not obtained, disengage HP turbine stator from small exit duct assembly and rotate stator slightly to engage in next position. Check and repeat until clearance is correct if necessary.

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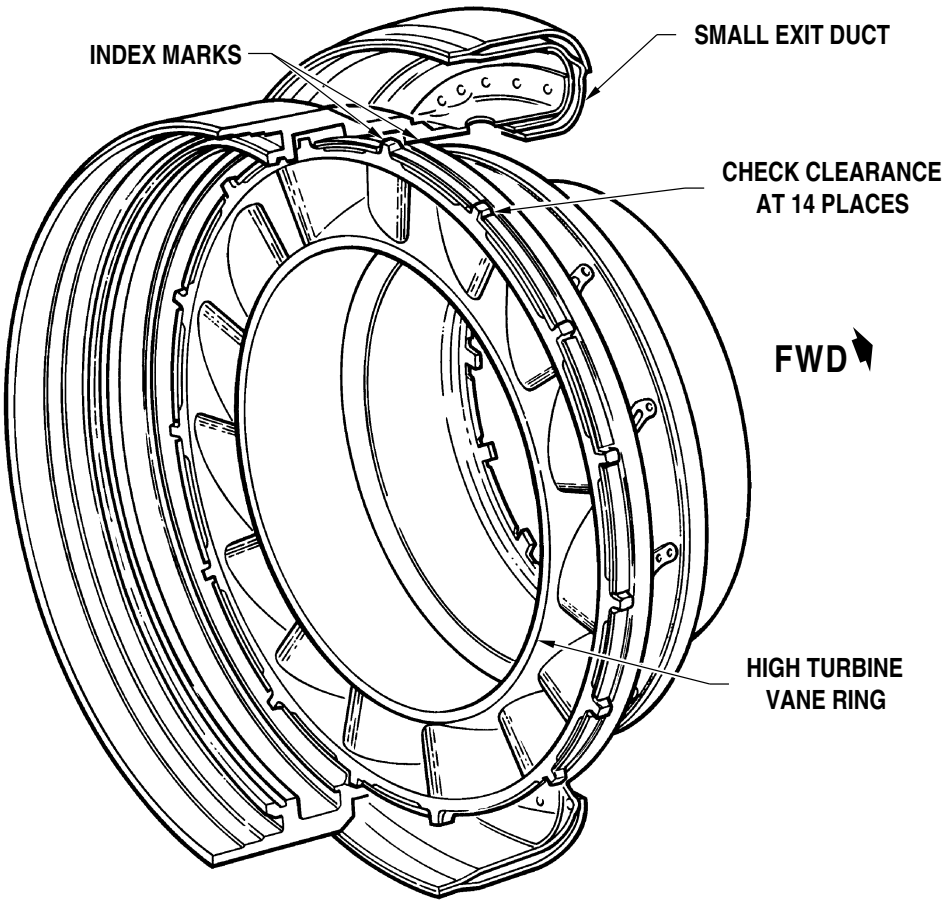

C10571

HP Turbine Vane Ring Lugs - Clearance Check
Figure 203

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CAUTION: DO NOT REMOVE MATERIAL FROM VANE RING LUG BY ANY METHOD OTHER THAN HAND STONING, IF REWORK IS REQUIRED.

(e) If correct clearance is not obtained in any position, rework by removing material from one lug only, until clearance is obtained for a 0.001 inch, but not for a 0.002 inch feeler gage.

(f) Following rework, temporarily assemble small exit duct ((13), Fig 201) and HP turbine stator (11). Vibropeen index marks (X) on components in locations indicated in Figure 203. At any subsequent reassembly, index marks must be aligned.

(g) Separate SED (13) and stator (11).

(4) JT15D-5 (Post-SB7273) and JT15D-5R engines: Fit seal ring (12) to HP turbine stator assembly (11) as follows:

(a) Position small exit duct assembly (13) on workbench with front end downward and install seal ring (12) with "PRESSURE SIDE" marking also facing down. Rotate seal ring to achieve best fit. Check fit between installed seal ring OD and small exit duct ID (see NOTES below).

NOTE: 1. Feeler gage (0.002 in.) must not pass between 360 degrees of Dimension A (Ref. Section B-B).

NOTE: 2. Feeler gage (0.001 in.) may pass for an accumulated length of approximately six inches of seal fit circumference.

NOTE: 3. Feeler gage check may be omitted if it was performed as part of small exit duct/seal ring inspection procedures (Ref. Subparas. 6.D. and 6.E.).

(b) Mark small exit duct assembly (13) with a temporary V-mark in line with gap in seal ring (12) using silver pencil (PWC05-018).

(c) Remove seal ring (12) from small exit duct (13) and install on HP turbine stator (11). Align small exit duct and stator X marks, then rotate ring on stator until ring gap is aligned with V on small exit duct. Install clips (PWC31195) over ring.

(d) Align X marks on small exit duct (13) and HP turbine stator (11). Mate HP turbine stator and seal ring assembly to small exit duct. Verify that stator is fully seated. Remove clips (PWC31195) previously installed at step (4)(c).

(5) Install original and/or replacement segment(s) (10) in original or required location(s) in small exit duct (13). Ensure a minimum gap of 0.010 inch between adjacent shroud segments. If required, rework end faces to obtain required clearances.

NOTE: For JT15D-5 Engines: Do not mix Pre-SB7273 and Post-SB7273 shroud segments. Replace single segment or full set of segments with segment of same part number only.

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(6) Remove HP turbine shroud support (9) from freezer and align part number with small exit duct (13) X-mark. Install support in small exit duct by tapping with a soft-faced hammer.

(7) Secure HP turbine shroud support (9) to small exit duct (13) with six retaining plates (15) and countersunk tubular rivets (14). Flare rivets using riveter (PWC31071).

NOTE: Verify that rivets are correctly flared and set.

(8) Verify that 24 nuts required to secure HP turbine stator and air seal assemblies, are in place on gas generator case. Replace damaged or missing nuts. For replacement of nuts, refer to Chapter 70-00-00, REPAIR.

(9) Install large exit duct assembly ((16), Fig. 201) by inserting in gas generator case, then rotating approximately 45 degrees to engage lugs of support bolted to gas generator and aligning bolt holes of mating flanges. Ensure reference mark aligns with engine top dead center.

(10) Remove previously installed blanking cap (PWC31512) from No. 3 bearing stator air seal.

(11) Install HP turbine air seal (6) in gas generator case with X-mark to engine top dead center, and align bolt holes. Install blanking cap (PWC31512) in No. 3 bearing stator air seal.

NOTE: If air seal was removed with stator, or in cases where lug/slot fit is very tight, seal and stator can be pre-assembled and offered up to gas generator case as an assembly.

(12) Install assembled HP turbine stator and small exit duct assembly in gas generator case with stator X-mark to engine top dead center. Engage stator lugs with slots on HP turbine air seal (6) and align bolt holes.

(13) If new or reworked HP turbine stator (11) was installed, refer to Chapter 72-50-02 for procedure to determine HP turbine positioning spacer dimension. Measure and record Dimension B for reference at installation of HP turbine.

CAUTION: TAKE PARTICULAR CARE TO ENSURE THAT ALL HP TURBINE STATOR INNER LUGS REMAIN FULLY ENGAGED IN THE HP TURBINE SEAL SLOTS THROUGHOUT TORQUING OF RETAINING BOLTS. ANY ATTEMPT TO FORCE ENGAGEMENT OF LUGS INTO SLOTS BY TIGHTENING RETAINING BOLTS WILL DAMAGE THE LUGS.

(14) Install retaining ring ((5), Fig. 201) with X-mark aligned to air seal (6) X mark. Install 24 bolts. Tighten and torque bolts 36 to 40 lb.in. using opposite bolt pattern, 180 degrees apart.

(15) If new or reworked HP turbine stator (11) was installed, refer to Chapter 72-50-02. Measure and record dimension B for HP turbine positioning spacer dimensioning

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(16) Install HP turbine baffle (4) and secure to HP turbine air seal (6) using three multiple thread plain nuts (7), three double keywashers (8) and six bolts (2). Tighten bolts, torque 24 to 36 lb.in., and secure bolts with keywasher tabs.

(17) Install interstage seal ring (1) on HP turbine shroud support (9).

CAUTION: REMOVE PREVIOUSLY INSTALLED BLANKING CAP, PRIOR TO INSTALLING HP TURBINE ASSEMBLY.

(18) Install HP turbine assembly (Ref. 72-50-02).

(19) Install LP turbine stator support assembly complete with fuel manifold system and combustion chamber liner (Ref. 72-40-01).

(20) Install second-stage LP turbine stator assembly (Ref. 72-50-04).

(21) Install LP turbine rotor balancing assembly (Ref. 72-50-03).

(22) Install turbine exhaust duct and No. 4 bearing housing assembly (Ref. 72-50-06).

6. Inspection/Check

A. Interstage Seal Ring (Ref. Fig. 201)

(1) JT15D-5 (Pre-SB7432) engines: Inspect interstage seal ring (1) for fretting wear and distortion. Light fretting is acceptable.

(2) JT15D-5 (Post-SB7432) and JT15D-5R engines: Inspect seal ring hooking ends. Hooking ends must engage. If hooking ends are broken or do not engage, reject and replace seal ring.

(3) JT15D-5 (Post-SB7432) and JT15D-5R engines: Inspect interstage seal ring (1) for fretting wear and distortion. Stone to remove raised metal. Light fretting wear on sealing face, other contact surfaces and to hooking area is allowable. Sealing ring can be reversed for continued operation.

(4) Check radial width of ring. Reject ring if less than 0.160 inch at any location.

(5) Check thickness of ring. Reject if less than 0.100 inch at any location.

B. High Pressure Turbine Air Seal and Baffle (Ref. Fig. 201)

(1) Inspect high pressure turbine air seal (6) and baffle (4) for distortion and cracks. Cracks are not allowable.

C. Shroud Segments (Ref. Figs. 201 and 204)

NOTE: Remove shroud segments from small exit duct (SED) only when required. Full separation of the SED assembly is only required at HSI, when shroud retaining ring, HPT stator or SED are damaged, or when numerous shroud segments are damaged.

(1) Acceptable HP turbine blade tip clearance:

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(a) Inspect retaining plates (15) and rivets securing shroud segments (10) to small exit duct (13) for security. Ensure rivets are correctly flared and set. Replace unacceptable rivets (Ref. Para. 7.).

(b) Inspect remaining shroud segments (10) installed in small exit duct for cracks, metal buildup, erosion, buckling and heavy rubs. Replace or repair unacceptable shroud segments (Ref. Para. 7.).

(2) Unacceptable HP turbine blade tip clearance:

(a) Inspect retaining plates (15) and rivets securing shroud segments (10) to small exit duct (13) and HP turbine stator (11) for security. Ensure rivets are correctly flared and set. Remove and replace unacceptable rivets (Ref. Para. 7.).

(b) Inspect shroud segments (10) at locations where unacceptable HP turbine blade tip clearance was recorded. Determine if grinding or replacement is required.

(c) Inspect remaining shroud segments (10) installed in small exit duct (13) for cracks, metal buildup, erosion, buckling and heavy rubs. Replace or grind unacceptable shroud segments (Ref. 7.).

(3) If shroud segments have been removed, inspect segments for metal buildup, erosion, buckling, heavy rubs and cracks at slots. Cracks which do not extend beyond first fillet radius are acceptable (Ref. Fig. 204).

(4) Retain shroud segments which have been removed to obtain correct turbine tip clearance. Such segments may be reused provided that inspection criteria are met; if witness step at segment rear is not evident, then minimum thickness after grinding is 0.100 inch.

D. Small Exit Duct (Ref. Fig. 205)

(1) Inspect small exit duct for cracks, wear caused by fretting, burning and distortion.

(2) Cracks evident around inner heatshield are acceptable up to 1-¼ inches long, subject to maximum of five cracks separated by at least three inches of sound material between each crack.

(3) Wear caused by fretting on contact surfaces b is acceptable up to a depth of 0.010 inch. If the above limits are exceeded, return exit duct to an approved overhaul facility.

(4) JT15D-5 (Pre-SB7273) engines only:

(a) Measure dimension X and determine sealing ring wear by subtracting dimension X (Detail A) from dimension Y obtained at Subpara. F.. Reject sealing ring if result is less than 0.025 inch.

(b) If limits above are exceeded, send duct to an approved overhaul facility for possible repair.

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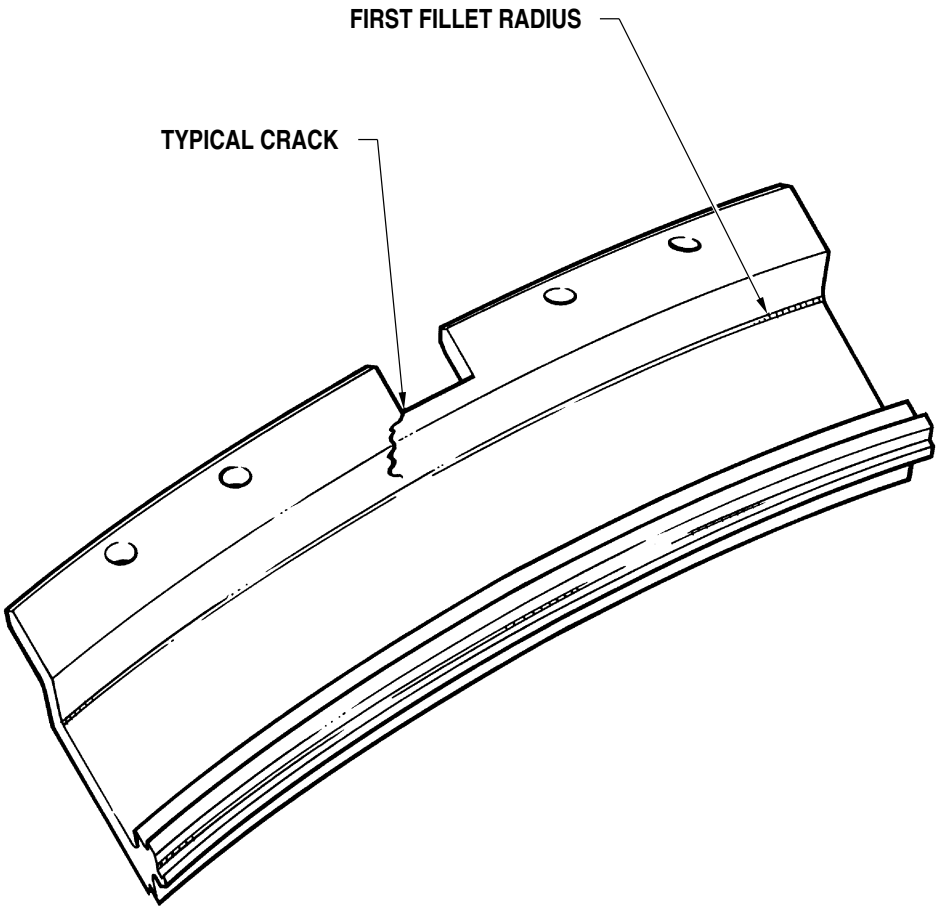

C2774A

High Pressure Turbine Shroud Segments - Crack Inspection
Figure 204

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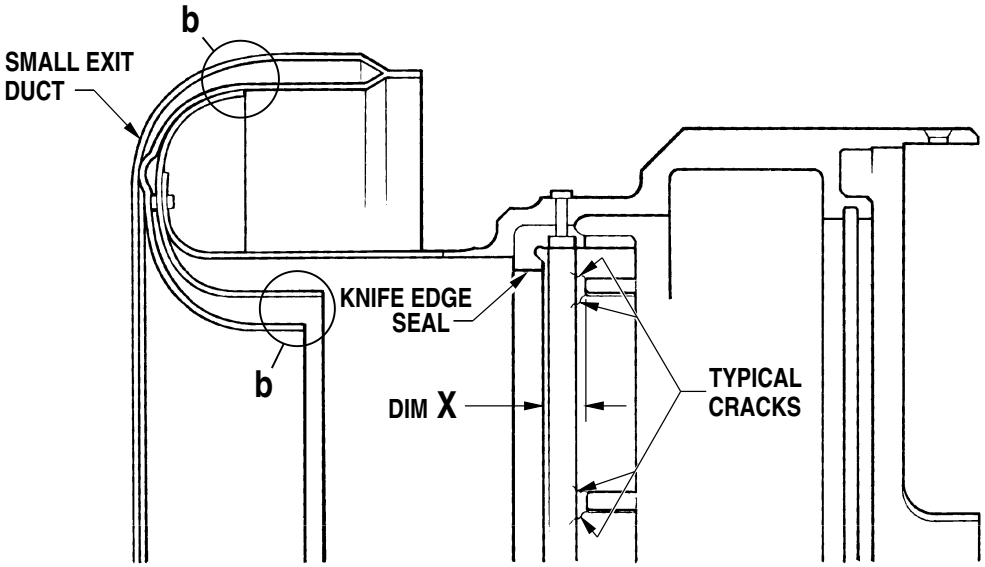
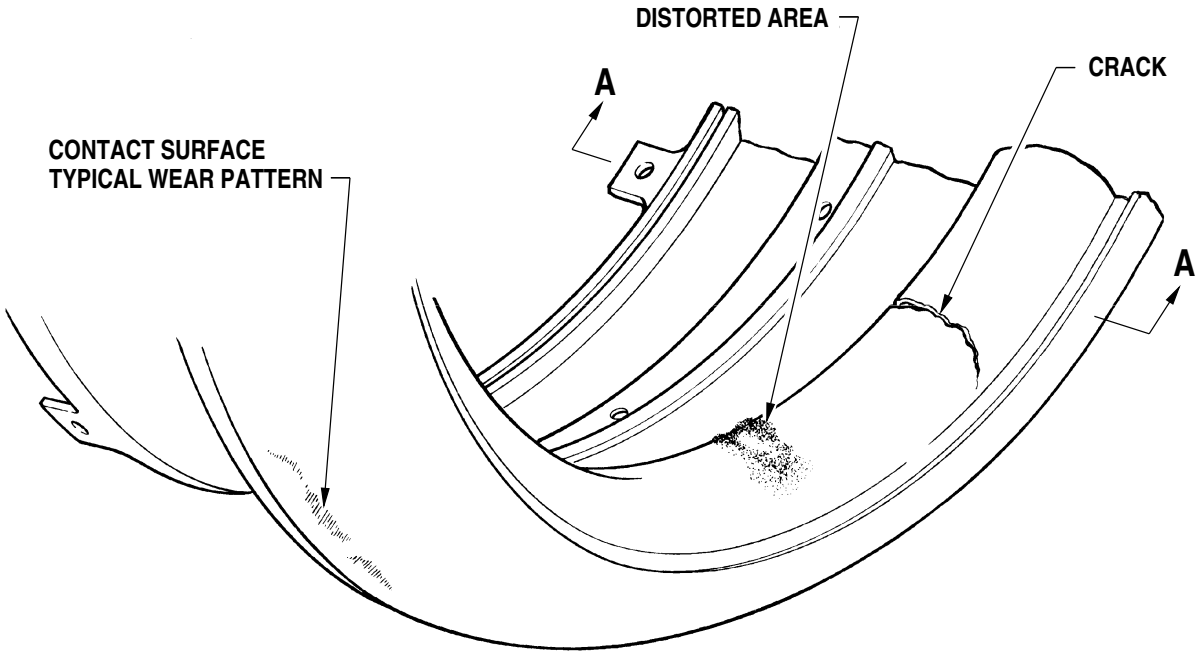


SECTION A–A
SMALL EXIT DUCT SECTION SHOWING DIMENSION X
JT15D–5 (PRE–SB7273)



C35972A

Small Exit Duct - Inspection
Figure 205 (Sheet 1 of 4)

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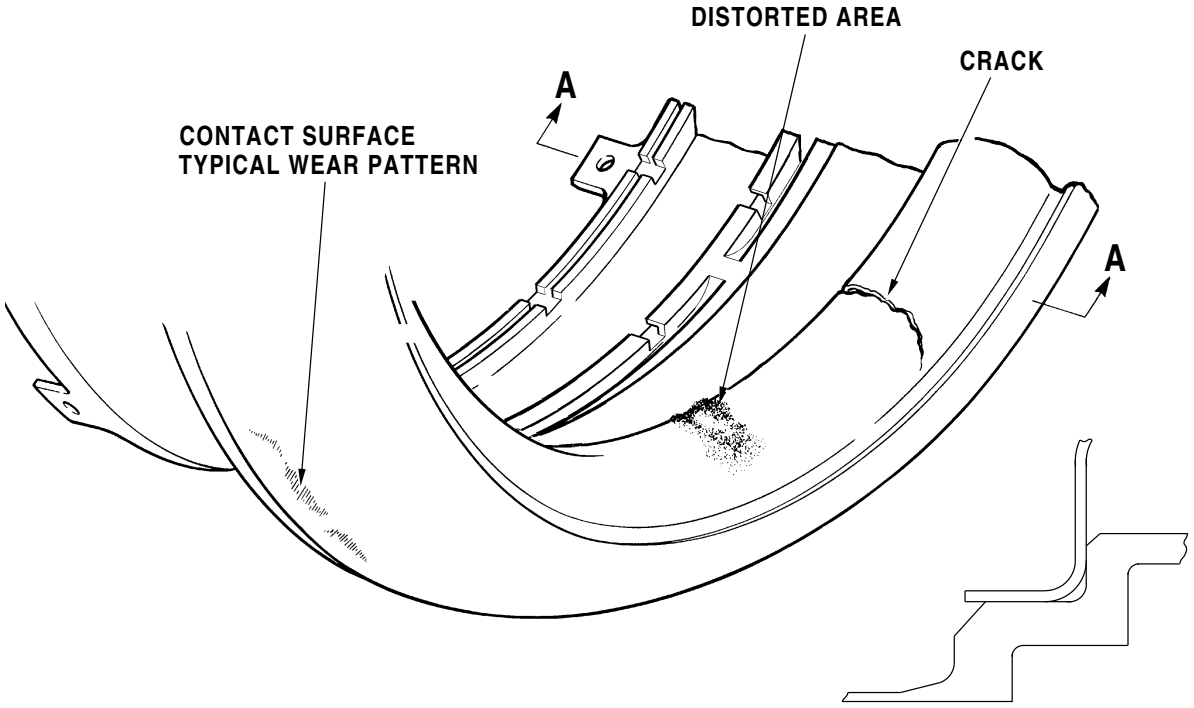

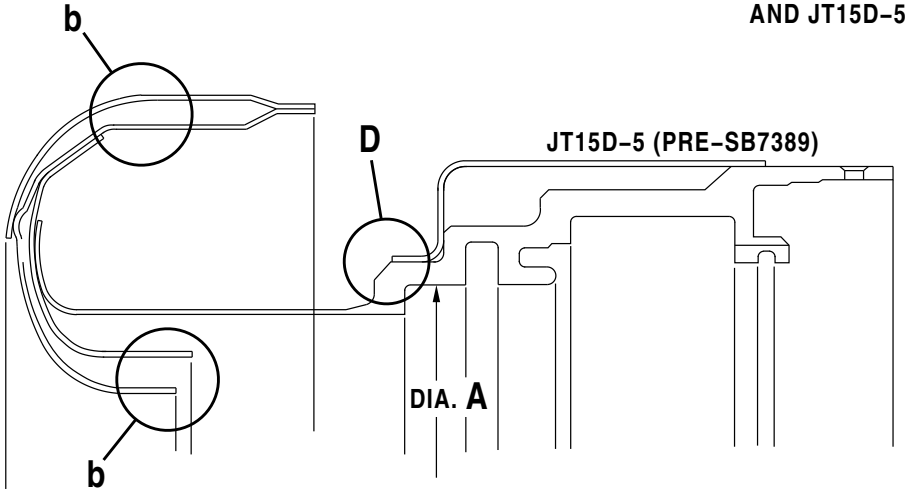

C35973B

Small Exit Duct - Inspection
Figure 205 (Sheet 2)

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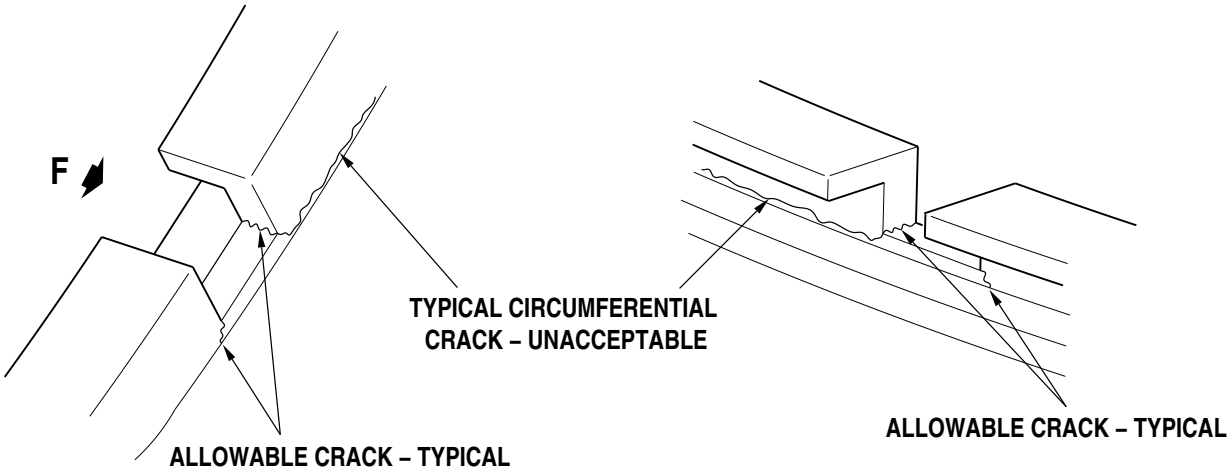
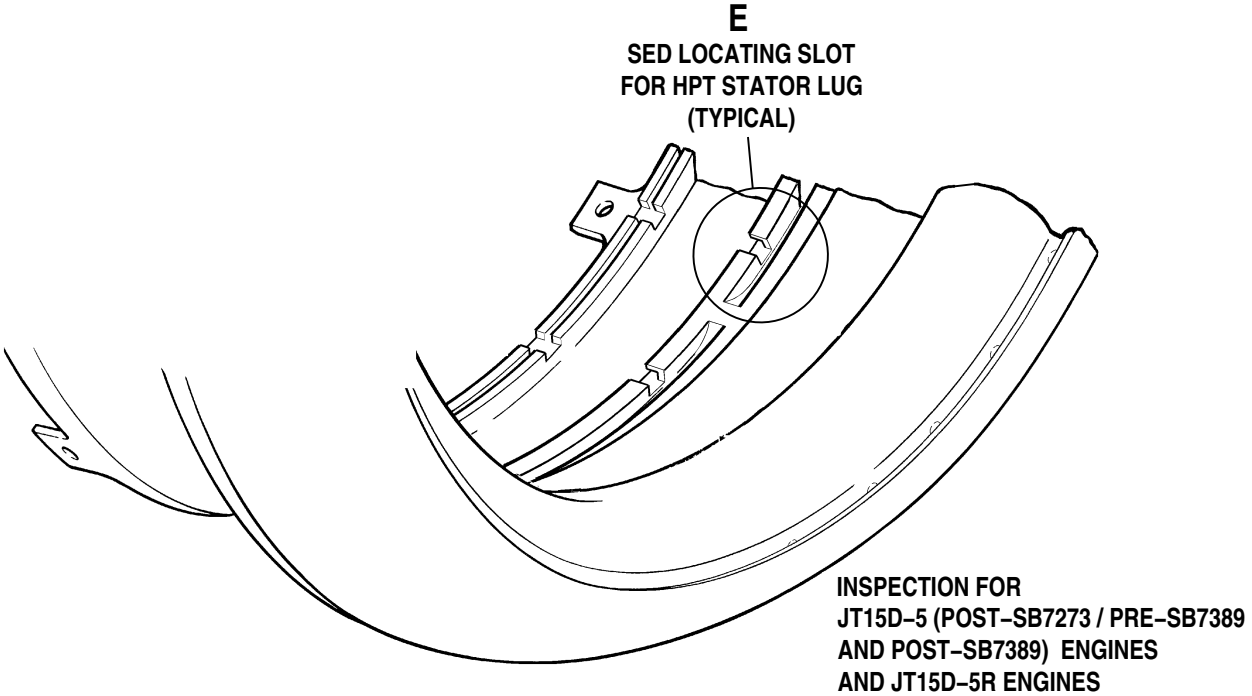


VIEW **F**

DETAIL **E**



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Small Exit Duct - Inspection
Figure 205 (Sheet 3)

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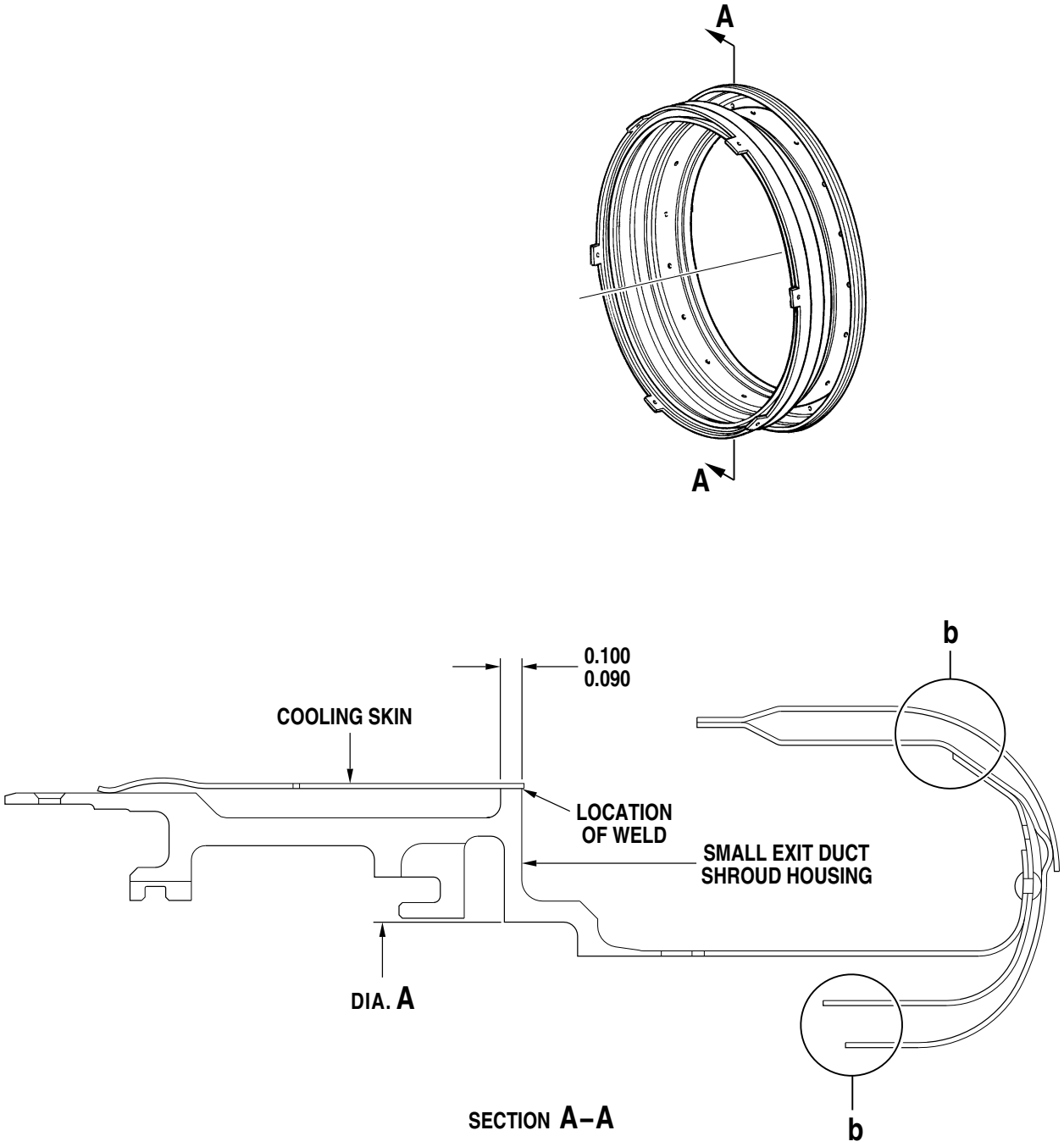

C92618C

Small Exit Duct - Inspection
Figure 205 (Sheet 4)

(c) Cracks emanating from sealing ring slot corners are acceptable provided they do not extend beyond fillet radius on inside diameter.

(5) JT15D-5 (Post-SB7273) and JT15D-5R engines only: Inspect Diameter A for wear, damage and distortion. Stone to remove raised metal and sharp edges. Local surface damage up to 0.002 inch deep is acceptable; if damage exceeds this limit, proceed as follows:

(a) Install HP turbine stator sealing ring in small exit duct with "PRESSURE SIDE" marking facing engine forward. Rotate ring to achieve best fit.

(b) A 0.002 in. feeler gage must not pass around 360 degrees of sealing ring fit.

(c) A 0.001 in. feeler gage may pass along seal fit circumference for an accumulated length of no more than six inches.

(d) If inspection criteria are not met using existing seal ring, replace ring and follow steps (a) through (c) above.

(e) If feeler gage inspection criteria are not met using replacement ring, return small exit duct to an approved overhaul facility.

(6) JT15D-5 (Post-SB7545) and JT15D-5R engines only: Visually inspect the cooling skin for cracks as follows:

(a) A maximum of two circumferential cracks up to 12 inches long are acceptable, provided they are a minimum of 10 inches apart.

(b) Longitudinal cracks up to 1.500 inches long are acceptable, provided the maximum number of cracks including the circumferential cracks is no more than six.

NOTE: Longitudinal cracks can be up to 45 degrees from the horizontal plane.

(c) Any visible cracks within these limits must be stopped drilled at both ends using a 1/32 drill bit. Cracks which propagate around the circumference of the cooling skin and which are parallel to and close to the weld, should be stop-drilled to the maximum depth. A shallow drill tip imprint in the SED shroud housing material is acceptable.

(d) For repair of the JT15D-5 (Post-SB7545) and JT15D-5R SED cooling skin, send the small exit duct to the following repair supplier:

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Chromalloy France
Avenue des Gros-Chevaux
Z.I. du Vert Galant
St-Ouen-L'Aumone
France 95310

TEL: 0-33-1-34-40-36-36
FAX: 0-33-1-34-21-97-37

Website: http://www.chromalloy.fr

E-mail: info@chromalloy.fr

(7) Visually inspect all HPT stator lug slots on SED (Ref. Detail E), on both sides, for cracks at corners.

NOTE: This inspection is applicable only if the SED and HPT stator are disassembled.

(a) Axial hairline and/or slanted axial hairline cracks originating from the corner of any slot are allowable.

(b) Hairline circumferential cracks, not exceeding 0.250 inch, from the root radius of any slot are allowable. Reject SED with hairline circumferential cracks exceeding 0.250 inch.

E. HP Turbine Stator Sealing Ring (Ref. Fig. 206)

NOTE: The HP turbine stator sealing ring is a JT15D-5 (Post-SB7273) and JT15D-5R part only.

(1) Inspect Face A (sealing face) for wear, damage and fretting. Stone to remove raised metal. Local surface damage up to 0.002 inch deep and which does not traverse across Face A is acceptable.

(2) Axial wear along surface F-F must not exceed 0.020 in.

(3) Install sealing ring in small exit duct assembly and perform feeler gage check of sealing diameter per procedure in Subpara. D.

(4) Reject sealing ring if it does not meet above criteria.

F. High Pressure Turbine Stator Assembly

NOTE: 1. The acceptance criteria given in Table 201 are based on considerations of structural integrity. If engine performance was unsatisfactory prior to Hot Section Inspection, open or displaced cracks (particularly at sealing face) are cause for rejection.

NOTE: 2. High pressure turbine stators exhibiting damage deemed in excess of allowable limits but repairable, may be returned to Pratt & Whitney Canada for possible repair.

(1) Inspect high pressure turbine stator assembly (Ref. Table 201 and Fig. 207).

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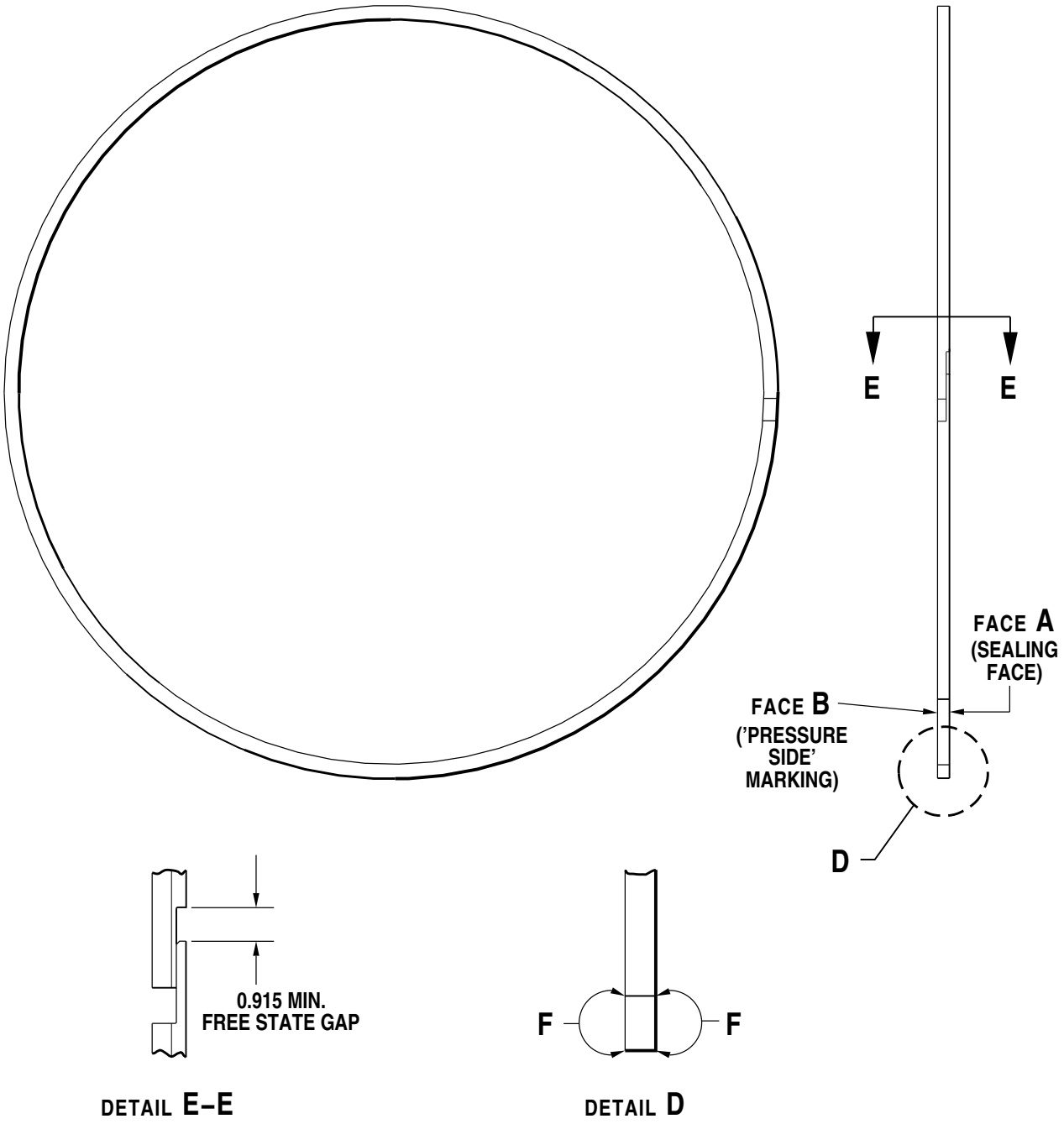

C30952C

HP Turbine Stator Sealing Ring - Inspection
Figure 206

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(2) JT15D-5 (Pre-SB7273) engines: If stator assembly is acceptable, check and record dimension Y at four diametrically opposite locations. Record average of dimensions for calculation required in Subpara. D.(4).

(3) If distressed vanes are encountered, but all other inspection limits are satisfied, high pressure turbine stator and small exit duct should be removed, rotated as a unit approximately 180 degrees and reinstalled. Check fuel nozzles for correct operation (Ref. 73-10-05).

(4) JT15D-5 (Pre-SB7273) engines: If HP turbine stator is acceptable but was removed for performance reasons, small exit duct knife-edge sealing wear is suspect; check sealing ring wear (Ref. Subpara. D.).

(5) JT15D-5 (Post-SB7273) and JT15D-5R engines: Inspect sealing ring grooves as follows:

(a) Check Faces D and F for raised metal and sharp edges. Stone to remove.

(b) Check Face D for damage or fretting. Local surface damage is acceptable to 0.002 inch deep provided damage does not traverse across full width of face.

(c) Check Face F for local surface damage. Damage is acceptable to 0.005 inch deep.

(6) High turbine stators exhibiting damage in excess of limits (Ref. Table 201, and Fig. 207) may be returned to Pratt & Whitney Canada for possible repair.

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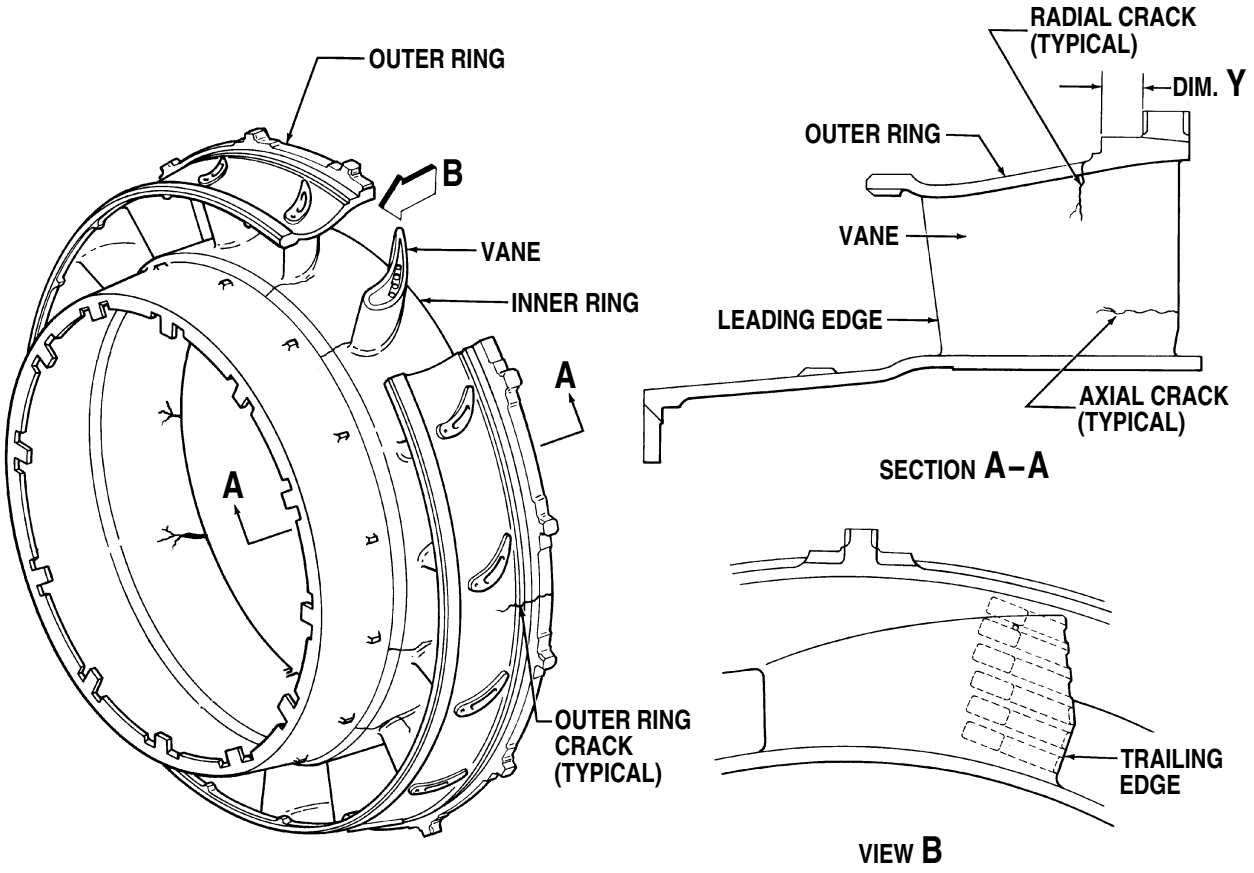

JT15D–5 (PRE–SB7273)

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High Pressure Turbine Stator Assembly - Inspection
Figure 207 (Sheet 1 of 2)

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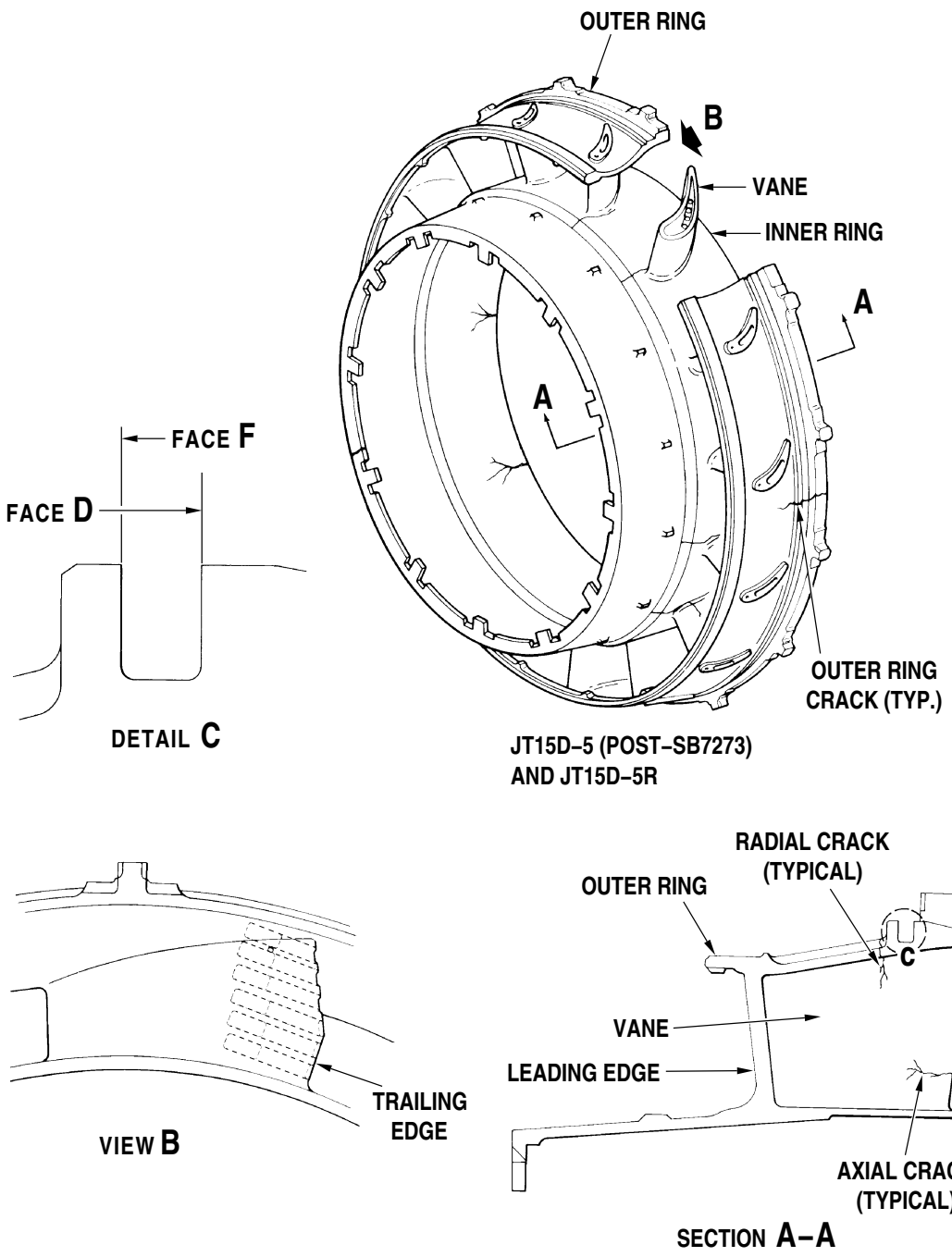

C35975A

High Pressure Turbine Stator Assembly - Inspection
Figure 207 (Sheet 2)

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TABLE 201, High Pressure Turbine Stator Assembly Inspection

INSPECTION	MAXIMUM SERVICEABLE	MAXIMUM REPAIRABLE
LOSS OF COATING		
Vanes	1.00 square inch on any airfoil surface on any number of vanes, provided parent metal erosion (if any) does not exceed 0.010 inch depth.	No repair required.
Outer ring	Complete loss of coating.	No repair required.
Inner ring	Complete loss of coating.	No repair required.
CRACKS*		
Vanes	One radial crack up to 1.250 inches long per vane on any number of vanes.	No repair required.
	Two axial cracks up to 0.500 inch long on any number of vanes.	No repair required.
Inner ring	Any number of through cracks, unlimited in length, are acceptable. Progression of cracks into vanes is acceptable.	No repair required.
* Cracks on any one vane must be separated by at least 0.100 inch.		
Converging cracks are not acceptable if progression could cause material to break away from ring.		
Outer ring	Three cracks, provided separated by at least 2.000 inches, may extend full width of outer ring and into an airfoil.	No repair required.
EROSION		
Vanes	0.010 inch deep on any airfoil surfaces on any number of vanes.	No repair required.

G. Large Exit Duct (Ref. Fig. 208)

(1) Fretting wear - inspect large exit duct for fretting wear on inner combustion chamber liner contact diameter: if fretting wear is in excess of 50 percent of original metal thickness at any point, return duct to an approved overhaul facility for possible repair.

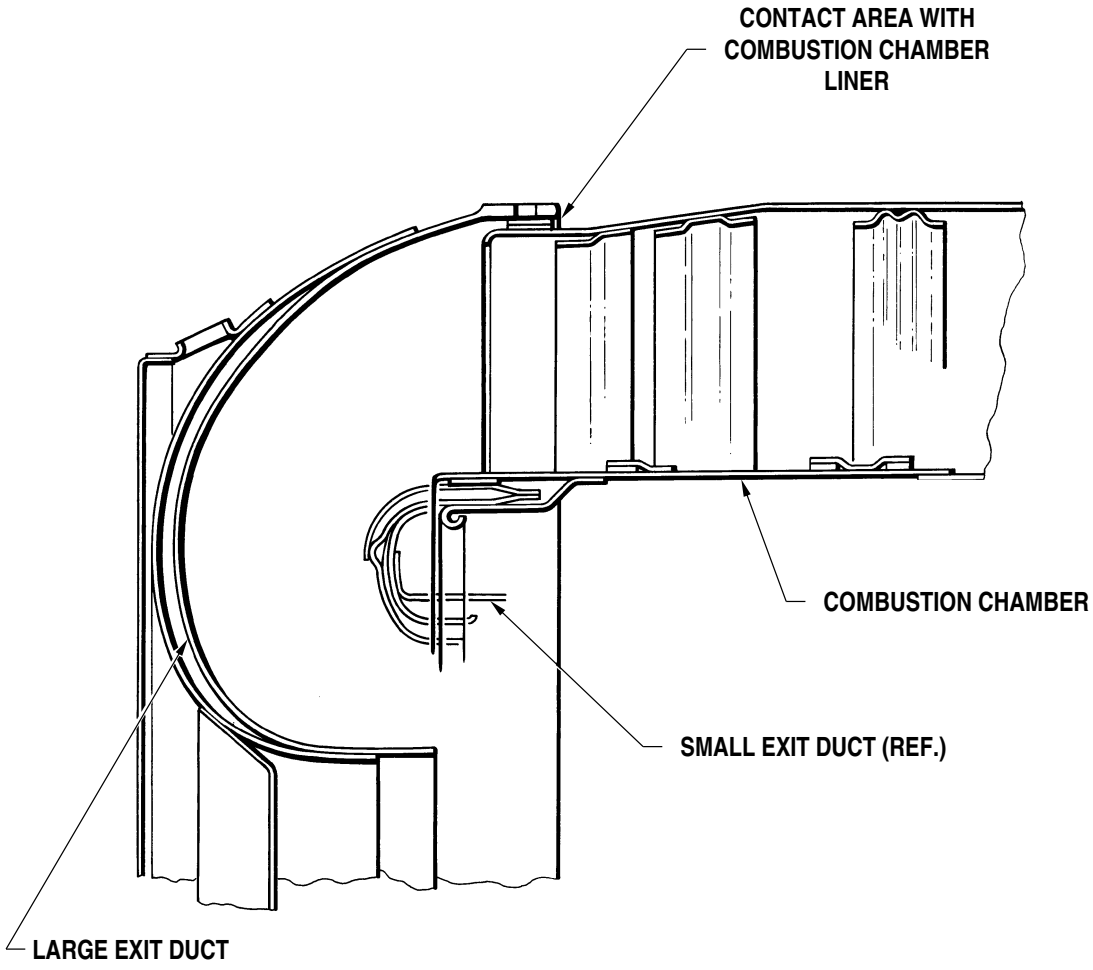
(2) Cracks- cracks up to one inch in length on duct periphery are allowable, provided that they do not converge and are repaired by stop drilling using a 1/16 inch drill.

7. Approved Repairs

A. HP Turbine Stator Assembly - Repairability Criteria

(1) Repairable - parts which appear to be repairable in accordance with the following criteria should be returned to P&WC for possible repair:

- Worn outer lugs.



C11385

Large Exit Duct - Inspection
Figure 208

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- Worn or missing inner lugs.
- Cracks in any airfoil surface (without guttering).
- Any number of cracks in the inner and outer drum.
- Outer drum cracks accompanied by material loss.

(2) Non-repairable - stators exhibiting bulging or having holes burned through any airfoil surface are not considered repairable.

B. HP Turbine Shroud Segments - Repair by Replacement

(1) Selection of Replacement Shroud Segments

NOTE: 1. Careful selection of class of replacement shroud segment(s) may provide required HP turbine blade tip clearance and eliminate need for shroud grinding.

NOTE: 2. Final shroud inside diameter, with or without shroud grinding, must provide required HP turbine blade radial tip clearance (Ref. 72-50-02, Fits and Clearances, REF. NO. 1086).

(a) If three or fewer shroud segments are to be replaced, determine turbine diameter group from Table 202 by doubling the length of longest HP turbine radius determined in Para. 5.A.. Select class of shroud segments which corresponds to this value.

(b) If four or more shroud segments are to be replaced, select segments from same class as remaining segments.

TABLE 202, Shroud Segment Class Selection

CLASS	CALCULATED SHROUD ID	TURBINE DIAMETER
6	11.998 - 11.994	11.952 - 11.948
8	11.990 - 11.986	11.944 - 11.940
10	11.982 - 11.978	11.936 - 11.932
12	11.974 - 11.970	11.928 - 11.924
14	11.966 - 11.962	11.920 - 11.916
16	11.958 - 11.954	11.912 - 11.908
18	11.950 - 11.946	11.904 - 11.900
20	11.942 - 11.938	11.896 - 11.892
22	11.934 - 11.930	11.888 - 11.884
24	11.926 - 11.922	11.880 - 11.876
26	11.918 - 11.914	11.872 - 11.868
28	11.910 - 11.906	11.864 - 11.860

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TABLE 202, Shroud Segment Class Selection (Cont'd)

CLASS	CALCULATED SHROUD ID	TURBINE DIAMETER
30	11.902 - 11.898	11.856 - 11.852
32	11.894 - 11.890	11.848 - 11.844
34	11.886 - 11.882	11.840 - 11.836
36	11.878 - 11.874	11.832 - 11.828

(2) Installation of Replacement Shroud Segments

(a) Install replacement shroud segment of required class in appropriate position in small exit duct and secure with HP turbine shroud support, retaining plates and rivets (Ref. Para. 5.B.).

(b) Grind replaced shroud segment(s) to obtain required HP turbine tip clearance, if necessary (Ref. Subpara. C., following).

C. Grinding of HP Turbine Shroud Segments (Ref. Figs. 202 and 209)

NOTE: Where available, use a lathe fitted with a grinding attachment to grind shroud segments. Lathe grinding is preferred because of better control over shroud segment diameter and concentricity.

(1) Refer to previously recorded information to determine which shroud segments require grinding.

(2) Install large exit duct (Ref. Para. 5.B.).

(3) Assemble and install HP turbine stator and small exit duct assemblies (Ref. Para. 5.B.).

(4) Install adapter (PWC31685) or (PWC31885)(7, Fig. 202) on HP turbine shaft and secure with HP turbine shaft locking nut (6). Tighten nut handtight using socket (PWC31035) or (PWC31835) to ensure adapter is seated on HP turbine positioning spacer.

(5) Secure radius gage (PWC31083) to adapter (PWC31685) with four bolts (4). Secure radius gage (PWC31683) to adapter (PWC31885) with three bolts (4).

(6) Install four spacers (PWC31084) (2) between small exit duct (SED) and large exit duct (LED) to load SED in running position.

(7) Measure shroud segment inside radii by rotating radius gage (5) and taking a deflection reading at center and butt ends of shroud segment(s) (11). Dimension on radius gage (5) calibrating block plus radius gage indicator dial deflection reading is equal to shroud segment inside radius.

(8) Remove dial indicator portion of radius gage (5) and calculate HP turbine blade tip clearance by subtracting longest turbine radius from shroud segment radii determined at previous step (7).

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(9) Compare calculated HP turbine blade tip clearances to required tip clearance limits (Ref. 72-50-02, Fits and Clearances, REF. NO. 1086):

(a) If calculated tip clearances are within limits, shroud grinding operation is not required.

(b) If calculated tip clearances are greater than maximum allowed limits, replace shroud segment with segment of larger class to reduce shroud inside diameter. Using radius gage (PWC31083) or (PWC31683), calculate tip clearance of replacement segment and determine if grinding is required.

NOTE: Retain shroud segments which have been removed to obtain correct HP turbine tip clearance. Such segments may be used if inspection criteria are met; if witness step at segment rear is not evident, minimum thickness after grinding is 0.100 inch.

(c) If calculated tip clearances are less than minimum allowable limits, segment(s) require grinding to increase tip clearance. Calculate thickness of metal which must be removed from shroud segment(s).

(10) Remove radius gage and check that blanking plug (PWC31511) (8) is installed in HP turbine shaft.

(11) Mask surrounding engine area, including diffuser ducts, thoroughly to prevent ingestion of metal dust into engine and into bearing areas in particular.

(12) Use of Adapter (PWC31685) and Grinding Fixture (PWC31068):

CAUTION: BEFORE SHROUD SEGMENT GRINDING, ENSURE ENGINE IS THOROUGHLY MASKED.

(a) Ensure grinding wheel (9, Fig. 209) (PWC32122-52) is secured to shroud grinding fixture (7). Secure fixture (PWC31068) to adapter (PWC31685) with four bolts (5). Connect air supply.

(b) Locate shroud segments which require grinding:

1 Extend threaded rod (11) on adapter (PWC31685) to segment high spot and establish a known clearance between tip of rod and shroud segment with a 0.005 inch feeler gage. Tighten threaded rod jam nut. Remove feeler gage.

2 After grinding, estimate thickness of metal removed by inserting a thicker feeler gage between fixed rod tip and shroud segment.

NOTE: Final check of HP turbine blade clearance must be done using radius gage (PWC31083).

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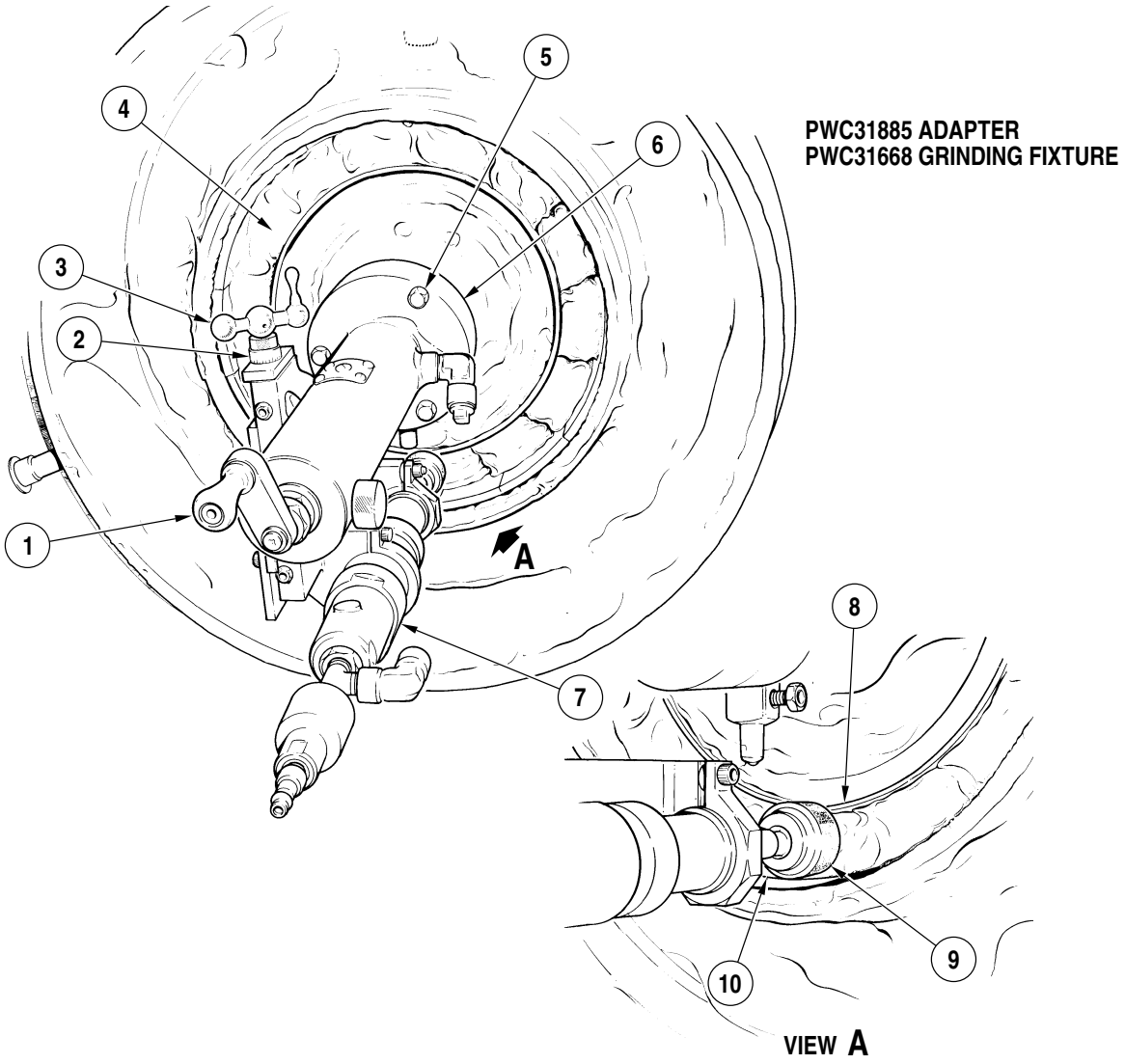

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HP Turbine Shroud Segment Grinding
Figure 209 (Sheet 1 of 2)

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Key to Figure 209

1. Axial Adjustment Wheel
2. Radial Adjustment Vernier
3. Radial Adjustment Wheel
4. Blanking Material
5. Bolt
6. Adapter
7. Shroud Grinding Fixture
8. HP Turbine Stator Rear Rim
9. Grinding Wheel
10. Shroud Segment
11. Threaded Rod
12. Spacer (PWC31084)

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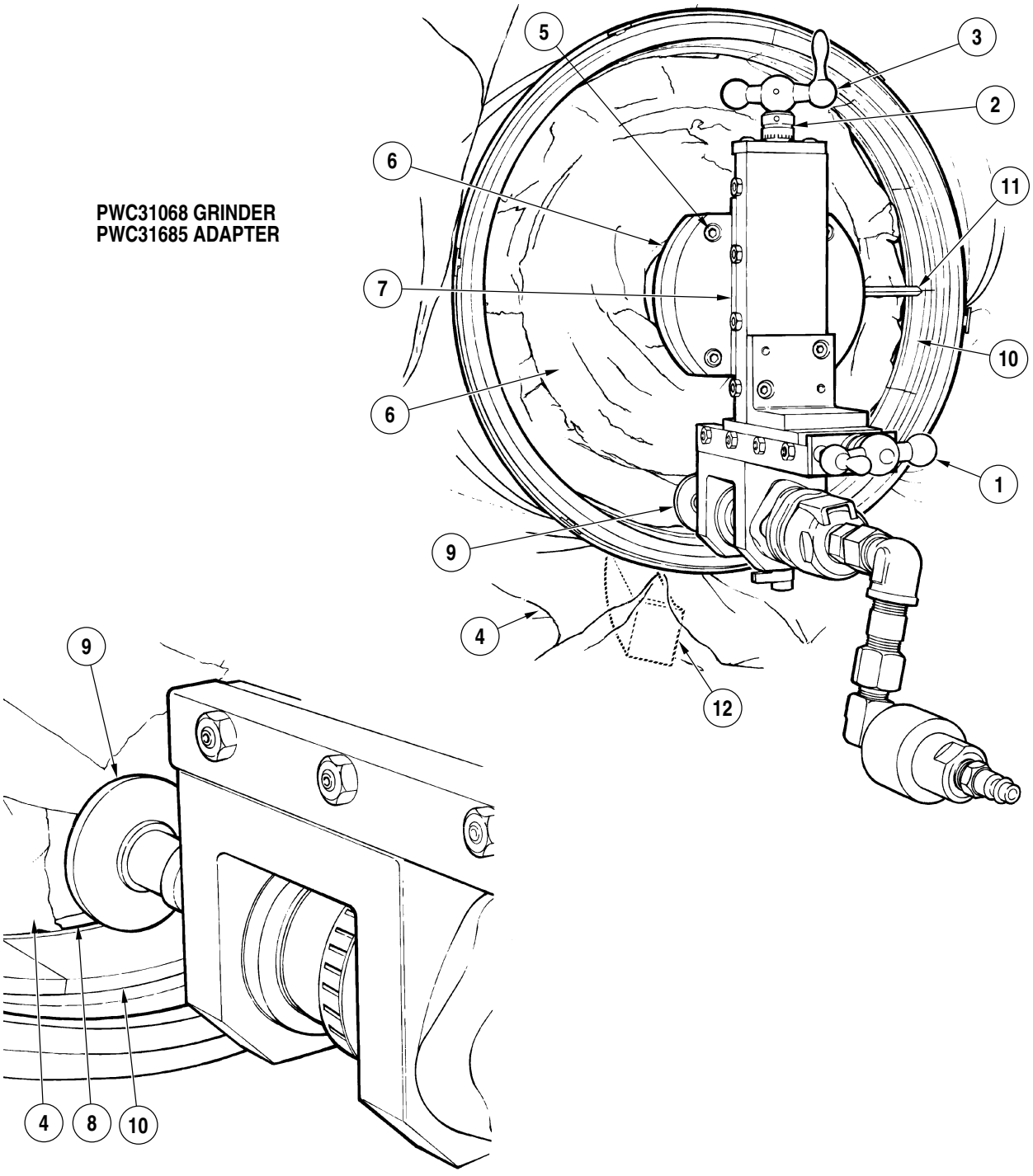
PWC31068 GRINDER
PWC31685 ADAPTER



C12980B

HP Turbine Shroud Segment Grinding
Figure 209 (Sheet 2)

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(c) With grinding fixture (7) stopped, position grinding wheel (9) using axial adjustment (1) so there is very slight contact with outer rear rim of HP turbine stator (8). Adjust fixture to eliminate slight contact with stator. Rotate fixture 360 degrees to ensure no contact with stator.

NOTE: Clockwise rotation of axial vernier (1) moves grinding wheel away from the engine. Clockwise rotation of radial vernier (2) moves grinding wheel away from segments.

(d) Rotate shroud grinding fixture (7) an initial 360 degrees and ensure no contact with shroud segments (10). While rotating fixture, turn radial adjustment wheel (3) until slight, initial contact is made at smallest shroud segments inside radius. Adjust radial vernier (3) one full turn in opposite direction to eliminate contact.

(e) Operate grinding fixture and move radial adjustment wheel (3) until grinding wheel (9) contacts shroud segments smallest inside diameters (high spots).

1 After one complete rotation of shroud grinder, keep operating fixture and move axial adjustment wheel (1) one complete turn clockwise. Rotate fixture 360 degrees at this axial position.

2 Repeat axial vernier adjustment after each 360 degree shroud grinder rotation until grinding wheel reaches outer edge of shroud segments (10)

NOTE: 1. Move radial adjustment wheel (3) in small increments only.

NOTE: 2. Where there are wide high spots on shroud segments, rotate shroud grinder back and forth through an arc of 40 to 50 degrees before full circumference grinding.

(f) With grinding wheel (9) in operation at outer edge of shroud segments (10), adjust radial wheel (3) until grinding wheel makes slight contact with shroud segments (10).

NOTE: Shroud segments (10) may form taper because of grinding wheel wear. After each full inward or outward pass, adjust radial position of grinding wheel (9) to compensate for wear as required using radial wheel (3).

(g) After one complete rotation of shroud grinder, keep operating fixture and move axial adjustment wheel (1) one complete turn counterclockwise. Rotate fixture 360 degrees at this axial position.

(h) Repeat axial wheel adjustments after each 360 degree shroud grinder rotation until grinding wheel reaches inner edge of shroud segments (10). Do not contact rear outer edge of HP turbine stator with grinding wheel in operation.

NOTE: A minimum of one full outward pass and one full inward pass must be made on shroud segments with shroud grinder to prevent a taper forming.

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(i) Measure approximate thickness of material removed using feeler gages inserted between tip of threaded rod (11) on adapter (6) and shroud segment (Ref. step (b)). Check for witness step at rear of shroud segment(s).

(j) Repeat grinding procedures to remove sufficient thickness of metal to obtain required HP turbine blade tip clearance (Ref. 72-50-02, REF. NO. 1086).

(k) Remove grinding fixture (PWC31068). Measure final blade tip clearances using radius gage (PWC31083). If correct, remove gage (PWC31083) and adapter (PWC31685).

(l) Using a suitable suction cleaner, remove all grinding residue from gas generator case to ensure absolute cleanliness of turbine area.

(m) Remove all blanking material and repeat step (l), preceding.

NOTE: If adhesive masking material is used, clean all areas with petroleum solvent (PWC11-027)).

(n) Blanking plug (PWC31511) must remain installed during cleaning and vacuum process and until further assembly necessitates its removal. If HP turbine assembly is not to be installed immediately, install blanking cap (PWC31512) over HP turbine shaft and air seal. Remove four spacers (PWC31084).

(13) Use of Adapter (PWC31885) and (PWC31668):

(a) With grinding fixture (7) stopped, position grinding wheel (9) using axial adjustment (1) so there is very slight contact with outer rear edge of HP turbine stator (8). Adjust fixture to eliminate slight contact with stator. Rotate fixture 360 degrees to ensure no contact with stator. Lock grinding fixture axial adjustment.

NOTE: Clockwise rotation of axial vernier (1) moves grinding wheel towards the front of the engine. Clockwise adjustment on radial vernier (2) moves grinding wheel toward the shroud segments.

(b) Rotate shroud grinding fixture (7) 360 degrees and ensure no contact with shroud segments (10). Operate fixture and rotate it constantly around shroud inside diameter. While rotating fixture, turn radial adjustment wheel (3) until slight, initial contact is made at shortest shroud segments inside radius.

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CAUTION: DO NOT GRIND LARGE AMOUNTS OF MATERIAL FROM SEGMENTS DURING SINGLE ROTATION OF GRINDING WHEEL.

(c) Move radial adjustment vernier (2) in small increments to dimension equal to thickness of shroud segment metal to be removed. Rotate fixture frequently to remove desired thickness of metal.

NOTE: 1. Each mark on vernier is radial adjustment of 0.001 inch.

NOTE: 2. Where there are broad high spots on shroud segments, rotate shroud grinder back and forth through an arc of 40 to 50 degrees before full circumference grinding.

(d) Remove shroud grinding fixture . Check for witness step at rear of shroud segment(s) (10).

(e) Secure radius gage (5, Fig. 202) dial indicator onto adapter (7). Measure shroud segments inside radius and calculate tip clearances at newly ground shroud segment (11) locations. If not acceptable, remove radius gage and install shroud grinding fixture (PWC31668). Dress shroud grinding wheel (PWC31669)and repeat shroud grinding operation. Repeat as required to obtain required HP turbine tip clearance limits (Ref. 72-50-02, Fits and Clearances, REF. NO. 1086,).

(f) Remove grinding fixture (PWC31668) and adapter (PWC31885).

(g) Using a suitable suction cleaner, remove all grinding residue from gas generator case to ensure absolute cleanliness of turbine area.

(h) Remove all blanking material and repeat step (g), preceding.

NOTE: If adhesive masking material is used, clean all areas with petroleum solvent (PWC11-027)).

(i) Blanking plug (PWC31511) must remain installed during cleaning and vacuum process and until further assembly necessitates its removal. If HP turbine assembly is not to be installed immediately, install blanking cap (PWC31512) over HP turbine shaft and air seal. Remove four spacers (PWC31084).

8. Fits, Clearances and Torque Loadings

A. Refer to Table 203 and Figure 210.

TABLE 203, Fits and Clearances

REF. NO.	Name	Dim. for Ref. (inches) Min.	Dim. for Ref. (inches) Max.	Limits (inches) Min.	Limits (inches) Max.	Limits (inches) Replace
1069	Seal, Air, High Pressure Turbine, Assembly of	7.3150	7.3190	0.0020	0.0080	
	Ring, High Pressure Turbine Stator Retaining	7.3210	7.3230			
1078	JT15D-5 (Pre-SB7545): Turbine Stator, HP	11.5880	11.5920	0.0150 RADIAL	0.0270	
	Duct, Combustion Chamber Exit, Small	11.6220	11.6420			
1078	JT15D-5 (Post-SB7545) and JT15D-5R: Turbine Stator, HP	11.5880	11.5920	0.0175 RADIAL	0.0295	
	Duct, Combustion Chamber Exit, Small	11.6270	11.6470			
1079	JT15D-5 (Pre-SB7545): Duct, Combustion Chamber Exit, Small	11.3000	11.3200	0.0080 RADIAL	0.0200	
	Turbine Stator, HP	11.3360	11.3400			
1079	JT15D-5 (Post-SB7545) and JT15D-5R: Duct, Combustion Chamber Exit, Small	11.2950	11.3150	0.0105 RADIAL	0.0225	
	Turbine Stator, HP	11.3360	11.3400			
1080	Stator, High Pressure Turbine	9.0100	9.0200			
	Duct Assembly, Combustion Chamber Exit, Large	9.0300	9.0500	0.0100	0.0400	

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TABLE 203, Fits and Clearances (Cont'd)

REF. NO.	Name	Dim. for Ref. (inches) Min.	Dim. for Ref. (inches) Max.	Limits (inches) Min.	Limits (inches) Max.	Limits (inches) Replace
1189	JT15D-5 (Pre-SB7432) Support-Shroud, High Pressure Turbine			0.0050	0.0160 SIDE CLEARANCE	
	Seal Ring, Metal, High Pressure Stator					
1189	JT15D-5 (Post-SB7432) and JT15D-5R Support-Shroud, High Pressure Turbine			0.0040	0.0130 SIDE CLEARANCE	
	Seal Ring, Metal, High Pressure Stator					
1214	JT15D-5 (Pre-SB7273) Sealing Ring, Combustion Chamber Exit Duct	12.4990	12.5010	0.0000	0.0050T	
	Combustion Chamber Small Exit Duct	12.3960	12.4990			
1216	Shroud Support High Pressure Turbine	13.4000	13.4020			
	Stator, Duct Combustion Chamber and Exit Duct	13.3970	13.3990	0.0010T	0.0050T	
1339	JT15D-5 (Post-SB7273) and JT15D-5R HP Turbine Stator			0.0030	0.0070 SIDE CLEARANCE	
	Stator Sealing Ring					

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TABLE 204, Torque and Stretch

REF. NO.	Name	Limits Min.	Limits Max.
	Not Applicable		

TABLE 205, Spring Pressure

REF. NO.	Name	Limits Min.	Limits Max.
	Not Applicable		

TABLE 206, Special Assembly

REF. NO.	Name	Limits Min.	Limits Max.
	Not Applicable		

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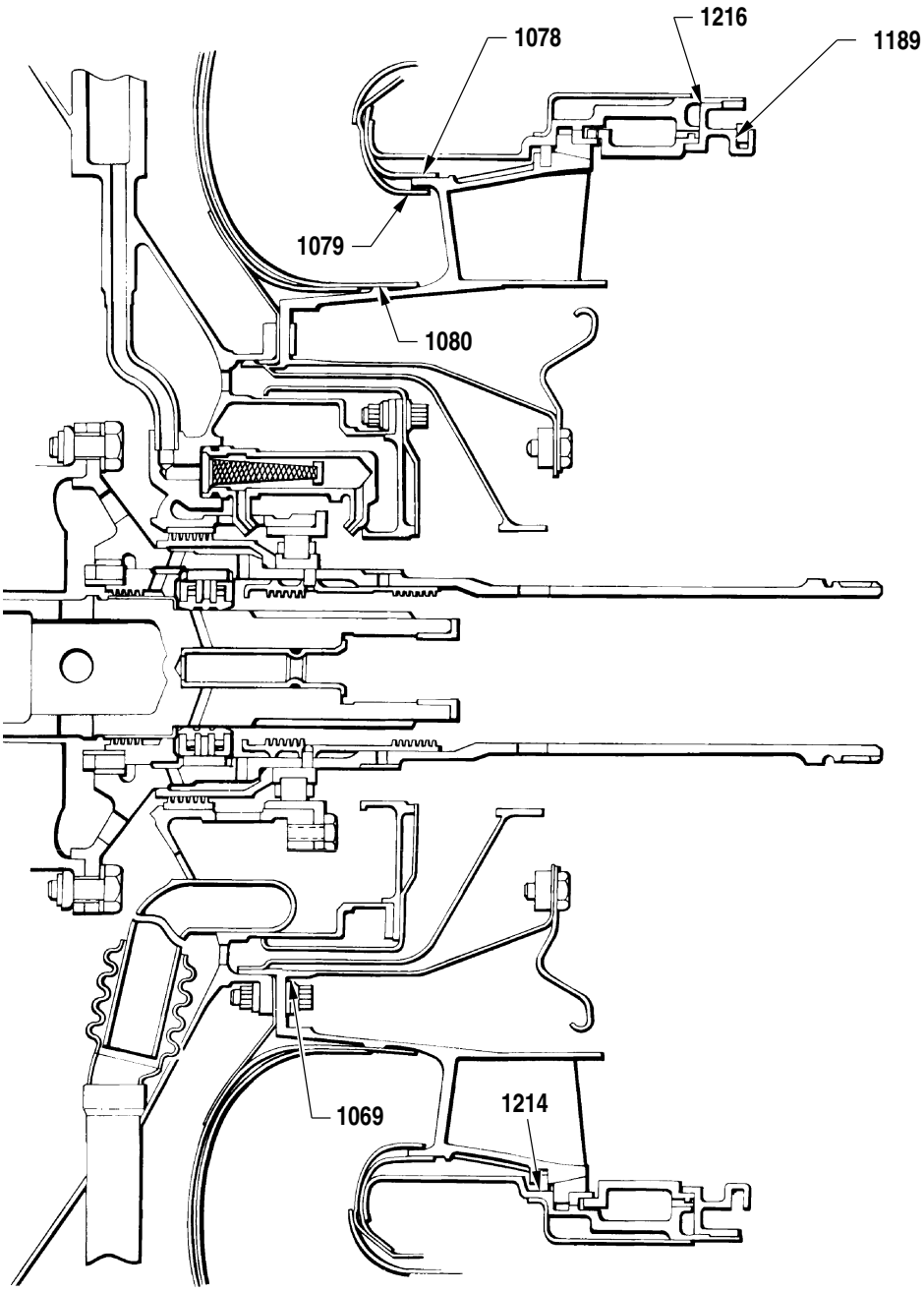

JT15D–5 (PRE–SB7273)

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Fits, Clearances and Torque Loadings
Figure 210 (Sheet 1 of 2)

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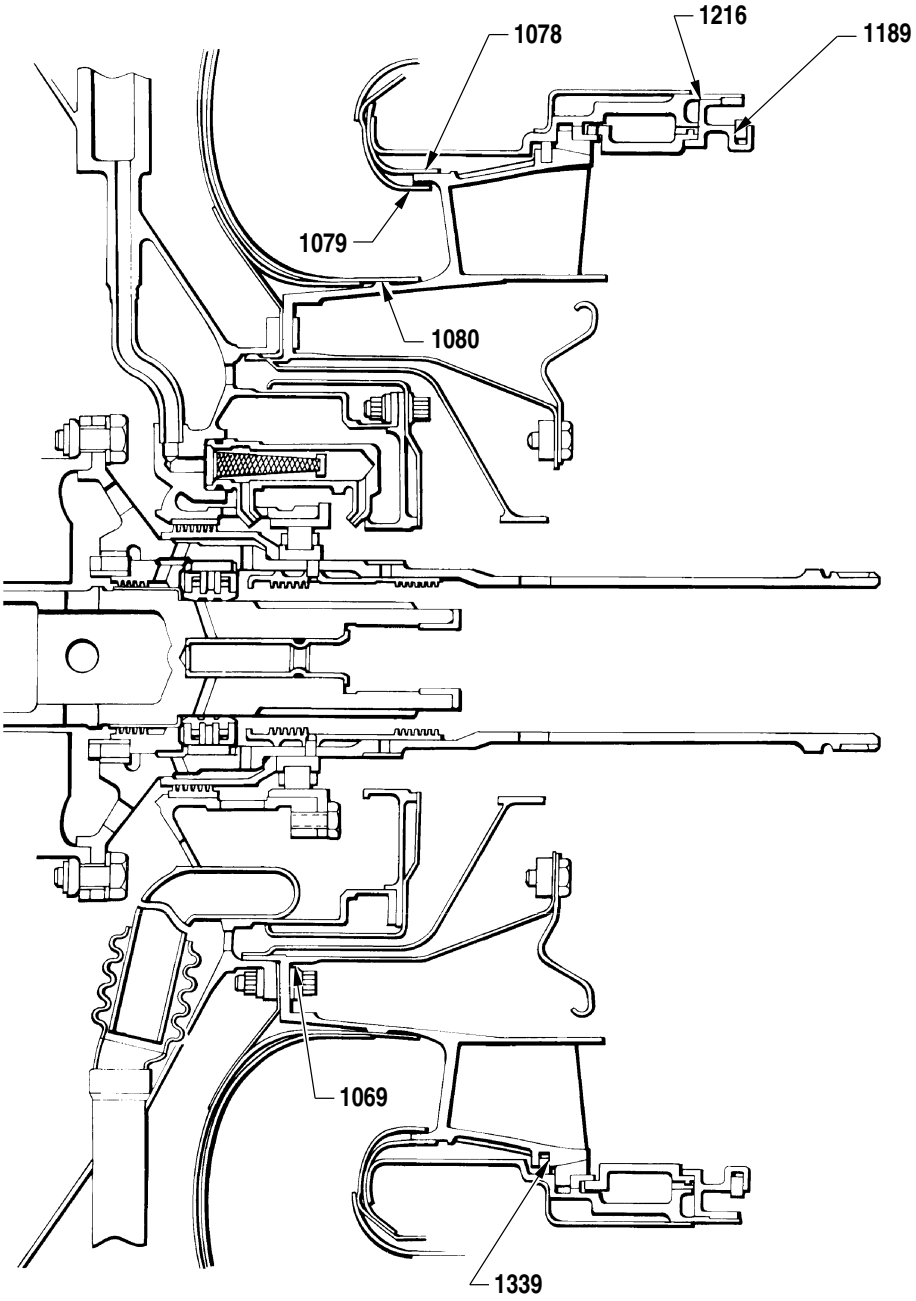

JT15D–5 (POST–SB7273) SHOWN
JT15D–5R SIMILAR

C23069A

Fits, Clearances and Torque Loadings
Figure 210 (Sheet 2)

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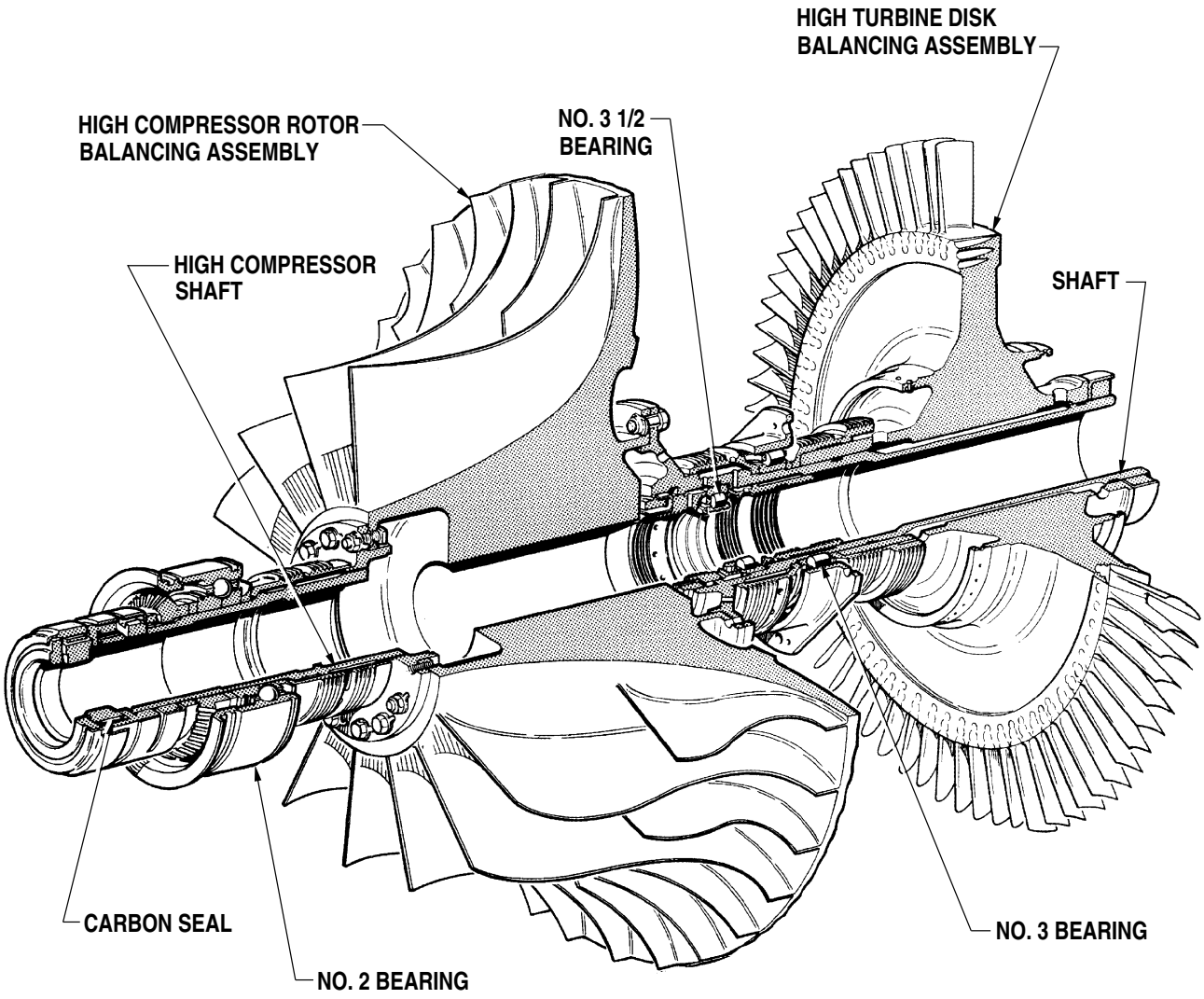
HP TURBINE DISK BALANCING ASSEMBLY - DESCRIPTION AND OPERATION

1. Description (Ref. Fig. 1)

The HP turbine consists of a two-plane balanced turbine disk, blades and classified counterweights. The turbine drives the HP compressor in a clockwise direction. Torque is transmitted to the impeller, via the HP rotor shaft, through splines machined in the inner surface of an integral stubshaft which extends forward from the turbine disk. The turbine is secured to the shaft at the rear by a plain round nut and keywasher. Its 71 blades are secured with individual rivets in fir tree serrations, machined in the outer circumference of the disk. The required number of classified counterweights is determined during balancing operations. Balance weights are riveted to the appropriate flanges machined forward and aft on the turbine disk.



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High Pressure Compressor Turbine Assembly (Typical)
Figure 1

HP TURBINE ASSEMBLY - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the HP turbine disk assembly.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC01-001	Engine Fuel
PWC03-001	Engine Lubricating Oil
PWC05-103	Pencil Marker
PWC06-009	Antiseize Compound

3. Special Tools

   The special tools listed below are used in the following procedures.

Tool No.	Name	Application
PWC30304-09	Set	
PWC30304-10	Set	
PWC31035	Socket	Use with PWC31050
PWC31050	Wrench	
PWC31065	Adapter	Use with PWC31050
PWC31078	Extension Bar	Use with PWC31050
PWC31084	Spacer	
PWC31237	OBSOLETE	Replaced by PWC31737
PWC31327	Collar Adapter	Use with PWC41050
PWC31511	Blanking Plug	
PWC31512	Blanking Cap	
PWC31517	Drilling Fixture, HPT Shaft Locking Nut	
PWC31534	OBSOLETE	Replaced by PWC32507 and Tool Set
PWC31636	Pad, HP Turbine Disk	Use with PWC41050
PWC31650	Ring	Use with PWC31065
PWC31654	Puller, No. 3 Bearing Rotor Air Seal	
PWC31687	Riveter	
PWC31734	Puller, HP Turbine Disk	Use with PWC32507
PWC31737	Crimper, HPT Disk Cupwasher	
PWC31835	Socket	Use with PWC41050

Tool No.	Name	Application
PWC31865	Collar, HP Turbine Disk	Use with PWC41050
PWC32505	DELETED	Replaced by PWC71392
PWC32506	DELETED	Replaced by PWC89837
PWC32507	Pump, HP Turbine Disk	
PWC41050	Wrench	
PWC52596	Disc Drift	
PWC52609	Stub Shaft Pad	
PWC71392	Hydraulic Adapter	Replaces PWC32505
PWC89837	Hydraulic Cylinder	Replaces PWC32506

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation (Heavy Maintenance Only)

   A. Removal of HP Turbine Disk Assembly (Ref. Fig. 201)

      (1) Remove turbine exhaust duct and No. 4 bearing housing assembly (Ref. 72-50-06).

      (2) Remove LP turbine rotor balancing assembly (Ref. 72-50-03).

      (3) Remove second-stage LP turbine stator assembly (Ref. 72-50-04).

      (4) Install spacers (PWC31084) between small exit duct (SED) and large exit duct (LED) to load SED in running position.

      (5) Using feeler gages, measure leading edge tip clearance of each HP turbine blade at 6 o'clock position and determine longest turbine radius. Mark blade at longest radius for reference with silver pencil marker (PWC05-103).

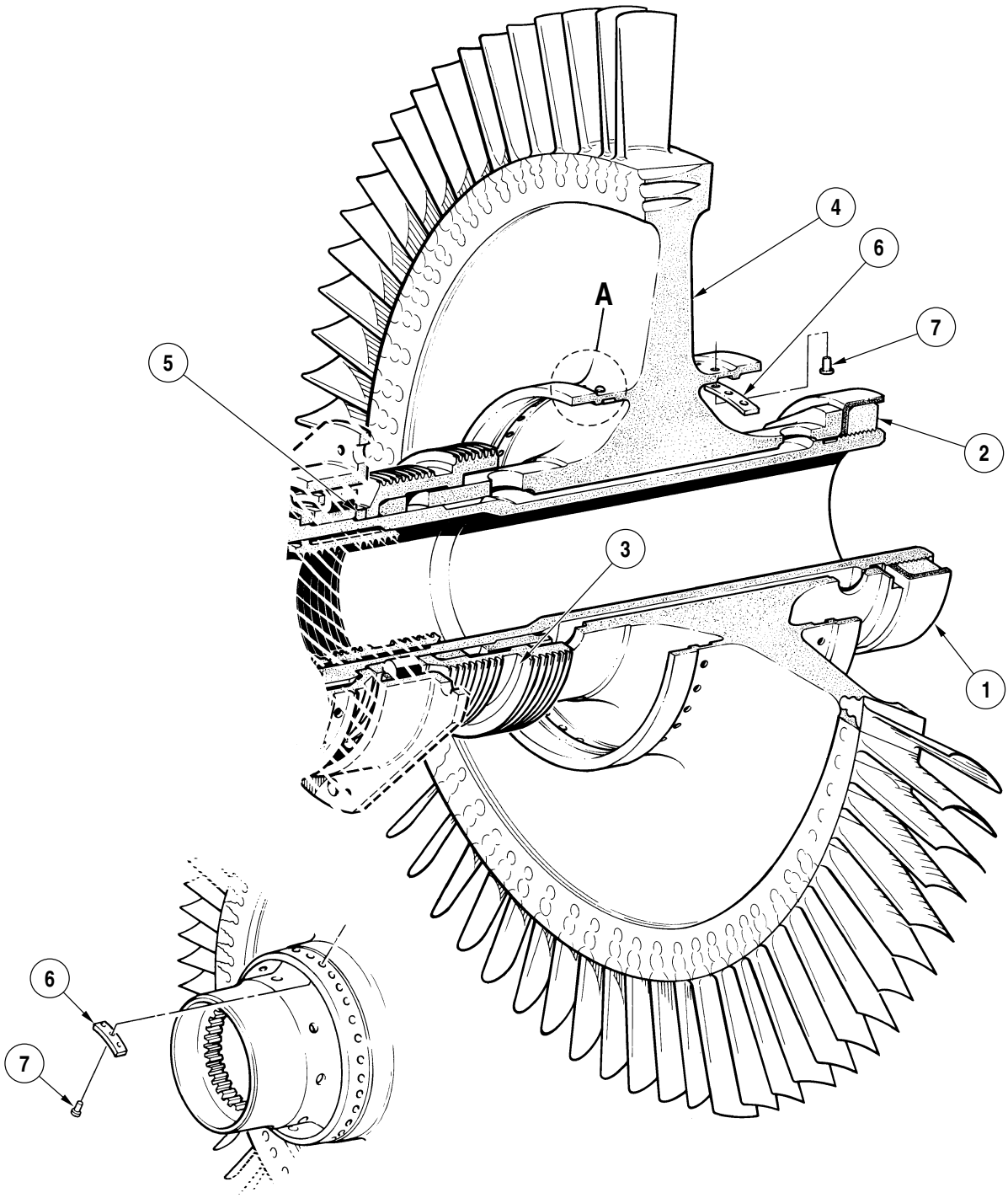
          NOTE: Measure tip clearance of each HP turbine blade at blade leading edge.

      (6) Using feeler gages, measure and record leading edge tip clearances between longest HP turbine blade and center and butt ends of each shroud segment.

      (7) Check that tip clearances are within acceptable limits (REF. NO. 1086, Table 202). If tip clearances are not within limits, length of longest HP turbine radius must be calculated and one or more shroud segments may require replacement or grinding (Ref. 72-50-01).

      (8) Remove assembled LP turbine stator support, fuel manifold system and combustion chamber liner (Ref. 72-40-01).

      (9) Apply a penetrating oil comprising of equal quantities of engine oil (PWC03-001) and engine fuel (PWC01-001) to locknut (2, Fig. 201) thread. Allow a soaking period of 30 minutes before removing locknut.



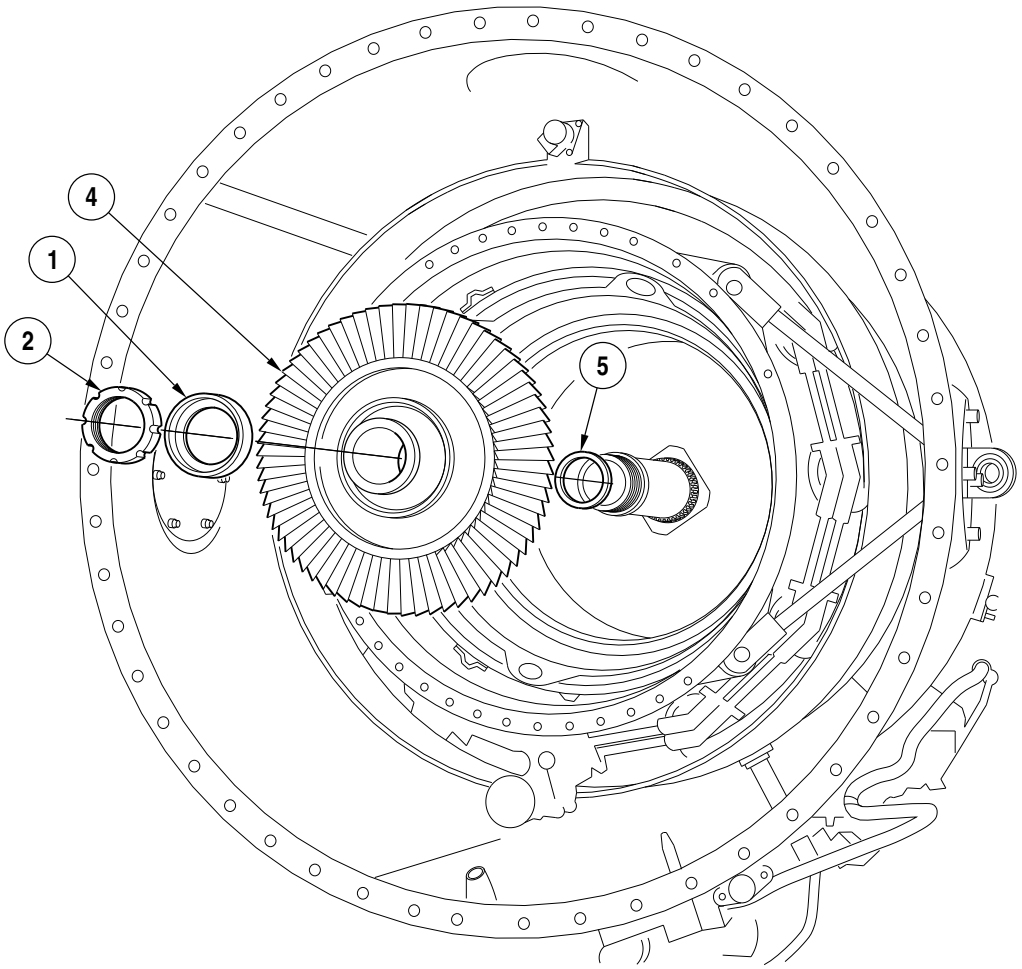
DETAIL A

C2133D

Removal/Installation - High Pressure Turbine Disk Assembly
Figure 201 (Sheet 1 of 2)

Key to Figure 201

1. Lockwasher
2. Locknut
3. Air Seal
4. High Pressure Turbine Disk
5. High Pressure Turbine Positioning Spacer (Ref.)
6. Trim Balance Counterweight
7. Rivet



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Removal/Installation - High Pressure Turbine Disk Assembly
Figure 201 (Sheet 2)

(10) Remove locknut (2) as follows:

(a) Unlock lockwasher (1) and pack bore of the HP turbine shaft with dry ice. If adapter (PWC31065) and wrench (PWC31050) are to be used, install ring (PWC31650).

(b) Install adapter on HPT disk (4):

1 For wrench (PWC31050): install adapter (PWC31065) on disk and tighten nuts fingertight. Check that adapter is seated on disk flats. Torque adapter nuts alternately 250 to 270 lb.in.

2 For wrench (PWC41050): install collar (PWC31865) on disk and tighten screws fingertight. Check that collar is seated on disk flats. Using a suitable Allen key, torque adapter screws alternately 250 to 270 lb.in.

CAUTION: MAXIMUM UNTORQUE VALUE FOR HPT DISK LOCKING NUT IS 12,000 LB-IN. (1000 LB-FT.)

(c) Remove HPT disk locknut (2) as follows:

CAUTION: ADAPTER MUST BE FULLY SEATED AND SECURED ON DISK FLATS BEFORE WRENCH IS OPERATED.

1 For wrench (PWC31050): Install socket (PWC31035), extension bar (PWC31078) and wrench (PWC31050). Operate wrench and loosen locknut (2). Remove tools, locknut and lockwasher (1). Discard lockwasher and discard JT15D-5 (Pre-SB7513) HPT shaft locking nut. Retain JT15D-5 (Post-SB7513) and JT15D-5R HPT shaft locking nut.

NOTE: If nut will not loosen with maximum allowable torque, refer to step (d).

CAUTION: ADAPTER MUST BE FULLY SEATED AND SECURED ON DISK FLATS BEFORE WRENCH IS OPERATED.

2 For wrench (PWC41050): Install socket (PWC31835), adapter (PWC31327) and wrench (PWC41050). Operate wrench and loosen locknut (2). Remove tools, locknut and lockwasher (1). Discard lockwasher and discard JT15D-5 (Pre-SB7513) HPT shaft locking nut. Retain JT15D-5 (Post-SB7513) and JT15D-5R HPT shaft locking nut.

NOTE: If nut will not loosen with maximum allowable torque, refer to step (d).

(d) Remove seized HPT locking nut using drilling fixture (PWC31517) as follows (Ref. Fig. 202):

1 Remove wrench and associated tools.

2 Install guide (6) into HPT shaft and engage locator in HPT nut socket.

3 Assemble two halves of body (2) around HPT disk flange and guide (6). Install and tighten two screws (1).

4 Tighten axial adjustment knob (3) to eliminate axial movement of fixture.

5 Use sharp-tipped starting drill (9) to drill initial hole to weaken nut (4).

6 Finish weakening nut with blunt-tipped finishing drill (10).

7 Remove fixture and repeat drilling operation in three more locations.

8 Remove drilling fixture (PWC31517).

9 Reinstall approved removal tools. Loosen and remove HPT nut.

10 Remove wrench and associated tools.

(11) With dry ice still packed inside high pressure turbine shaft, heat the high pressure turbine disk with a hot air blower to ease removal of disk tight snap diameter from the high pressure turbine shaft snap diameter.

CAUTION: TAKE CARE TO AVOID DAMAGE TO TURBINE BLADES AND HIGH PRESSURE TURBINE SHROUD SEGMENTS.

CAUTION: ENSURE THAT HIGH PRESSURE TURBINE POSITIONING SPACER (5), IF DISPLACED FROM SHAFT LOCATION, IS RETAINED TO AVOID POSSIBLE OMISSION AT REASSEMBLY.

CAUTION: INSTALL BLANKING CAP (REF. PWC31512) OVER HIGH PRESSURE TURBINE SHAFT TO PROTECT NO. 3 BEARING AND SURROUNDING AREA. REMOVE ONLY TO ACCOMPLISH SUBSEQUENT OPERATIONS, THEN REINSTALL IMMEDIATELY.

(12) Install pad (PWC31636) in HP turbine shaft. Install puller (PWC31734) and attach to assembled pump (PWC32507) and cylinder (PWC89837) with adapter (PWC71392). Operate pump and remove HP turbine disk (4). Remove tooling and disk.

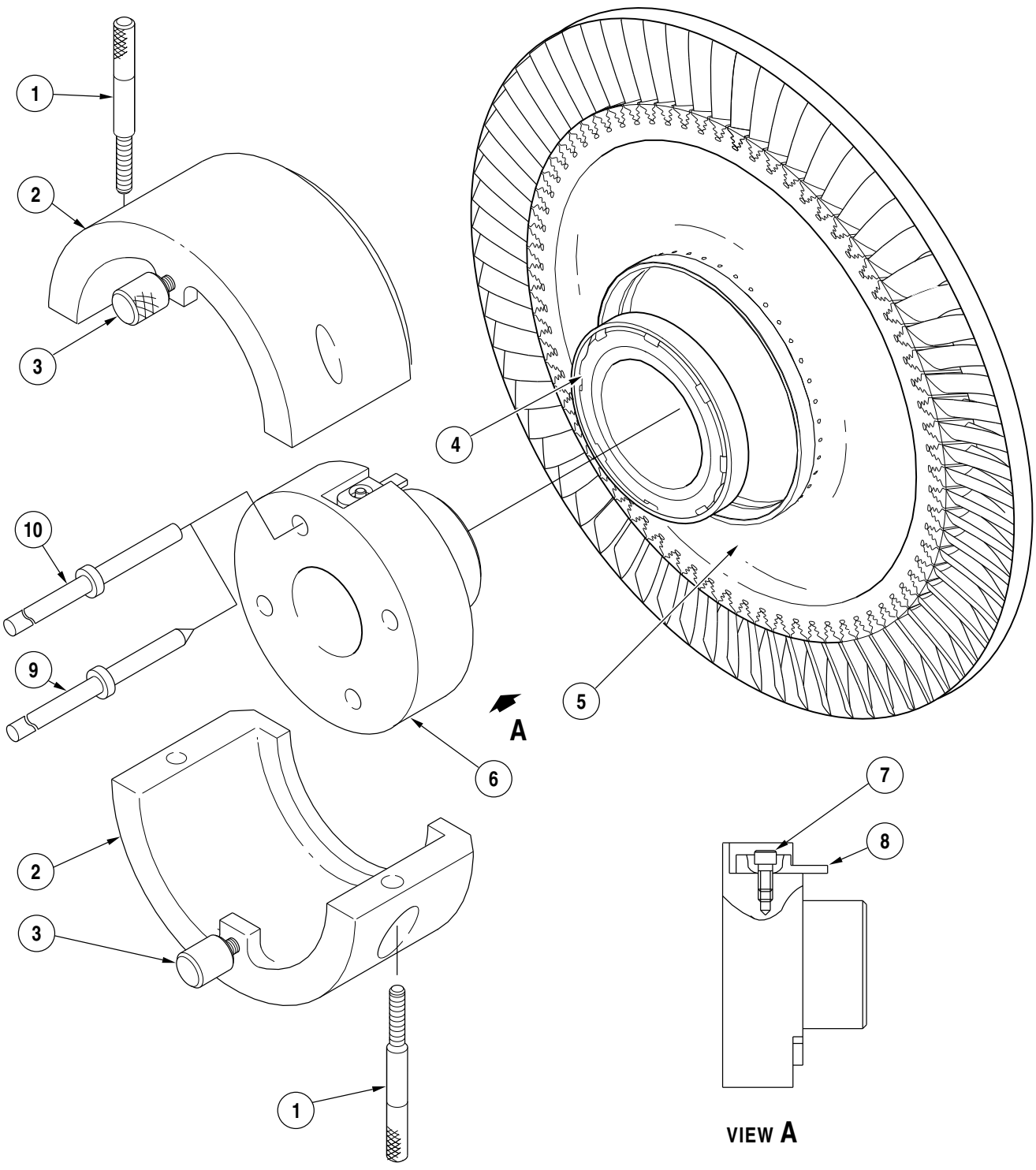
(13) Install plug (PWC31511) in HP turbine shaft. Install cap (PWC31512) in No. 3 bearing air seal.

(14) If required, extract air seal (3) from high pressure turbine disk (4) using puller (PWC31654).

(15) Inspect HP turbine disk assembly (Ref. Para. 7.).

(16) If HP turbine disk assembly is to be shipped for servicing or a replacement disk assembly ordered, log book or engine trim data plate trim balance counterweight locations must be specified to service facility. This permits convenient field installation of repaired or replacement engine trim balance counterweights configuration by identifying balance rim locations where counterweights cannot be installed when disk is detail-balanced.

(17) Store HP turbine disk in a suitable protective container.



HPT DISK SHOWN INSTALLED C73497

Use of HPT Nut Drilling Fixture
Figure 202

Key to Figure 202

1. Threaded Screw
2. Fixture Body
3. Axial Adjustment Knob
4. HPT Shaft Locking nut
5. HPT Disk
6. Guide
7. Locator Screw
8. Locator
9. Starting Drill
10. Finishing Drill

B. Installation of HP Turbine Disk Assembly (Ref. Fig. 201)

CAUTION: IF A NEW OR REPLACEMENT HP TURBINE IS TO BE INSTALLED, REFER TO PARAGRAPH 6., FOLLOWING.

NOTE: Shroud segment replacement and/or shroud grinding may be necessary if a new or replacement high pressure turbine disk assembly is to be installed (Ref. Para. 8.).

(1) Heat air seal (3) in oven at 204°C (400°F) for 10 minutes minimum.

(2) Remove air seal (3) from oven and install on HP turbine disk (4), aligning air seal V-mark with disk master spline.

(3) Check that front and rear mating faces and bore of turbine disk (4) are clean and free of burrs which may cause uneven seating of disk. Heat disk for 30 minutes at a temperature of 232°C (450°F).

(4) Check that mating faces on front and rear spigots on HP turbine shaft are clean and free of burrs which may cause uneven seating of disk (4).

(5) Lubricate HP turbine shaft, lockwasher (1) and locknut (2) with anti-seize compound (PWC06-009).

NOTE: Do not lubricate lockwasher and turbine mating faces. Mating faces must be clean and dry.

(6) Remove shaft blanking cap (PWC31512) and shaft blanking plug (PWC31511).

CAUTION: IF REPLACEMENT HP TURBINE POSITIONING SPACER IS TO BE INSTALLED, SPACER MUST BE CORRECTLY DIMENSIONED IN ACCORDANCE WITH PARAGRAPH 6.B., FOLLOWING.

(7) Install HP turbine positioning spacer (5) on HP turbine shaft with V-mark aligned to shaft master spline.

CAUTION: ENSURE THAT HP TURBINE POSITIONING SPACER HAS BEEN INSTALLED BEFORE INSTALLING HP TURBINE DISK ASSEMBLY.

CAUTION: DO NOT DRIVE DOWN AND SEAT HIGH TURBINE DISK ASSEMBLY USING WRENCH.

(8) Remove HP turbine disk (4) from oven and align V-mark with HP turbine shaft master spline. Install on shaft.

NOTE: HP turbine disk assembly should be seated by hand. Disk must freely enter final seating position prior to installing nut and lockwasher. If resistance is felt, remove and reinstall disk in accordance with steps (3) through (8).

(9) Optional procedure to apply hydraulic seating load to the HPT disk as follows:

NOTE: The HPT disk may be installed with or without the use of hydraulic pre-loading equipment.

(a) Remove and retain nut from pad of stub shaft (PWC52609), and install stub shaft pad (PWC52609) on HP turbine shaft. Install disk drift (PWC52596) over stub shaft (PWC52609). Install cylinder (PWC89837) on shaft of pad stub (PWC52609) and install previously removed nut to secure cylinder in position.

(b) Connect pump (PWC32507) to cylinder (PWC89837), and operate pump to apply load to HPT disk assembly per procedure on Special Assembly Table 205, REF. NO. 1934.

(c) Maintain load until parts cool to ambient temperature.

(d) Remove tools.

(10) Install adapter on HP turbine disk (4):

(a) For (PWC31050) wrench, install ring (PWC31650) and adapter (PWC31065) on disk. Tighten adapter nuts fingertight. Check that collar is seated on disk flats. Torque adapter nuts alternately 250 to 270 lb.in.

(b) For (PWC41050) wrench, install collar (PWC31865) on disk and tighten screws fingertight. Check that collar is seated on disk flats. Using a suitable Allen key, torque adapter screws alternately 250 to 270 lb.in.

CAUTION: ADAPTER MUST BE FULLY SEATED AND SECURED ON DISK FLATS BEFORE WRENCH IS OPERATED.

(11) Install lockwasher (1) and JT15D-5 (Post-SB7513) and JT15D-5R locknut (2). Install socket (PWC31035), extension bar (PWC31078) and wrench (PWC31050) tool set or install socket (PWC31835), adapter (PWC31327) and wrench (PWC41050) tool set.

(12) **Follow the procedures in this step if no optional hydraulic tools were used to apply a load to the HPT disk.**

NOTE: 1. Apply initial torque while HP turbine disk is still hot. Allow disk to cool to room temperature before removing and reinstalling tools and shaft locking nut, and applying final torque. This does not apply to a HPT disk which has been seated using step (9) optional hydraulic pre-loading method.

NOTE: 2. When the specified torque is reached, the reading may drop rapidly. Maintain torque until reading has stabilized for one minute.

CAUTION: DO NOT EXCEED 4200 LB.IN. TORQUE.

(a) Operate the wrench and apply seating torque of 4200 lb.in. (350 lb. ft). Loosen to zero lb.in. and remove the nut.

NOTE: Prior to each tightening of the nut, wipe clean and re-apply anti-seize compound (PWC06-009) to the nut threads, the shaft threads, the nut thrust face and its mating face.

CAUTION: DO NOT EXCEED 4200 LB.IN. TORQUE.

(b) Tighten nut to 300 lb.in.

(c) Establish common reference points between the nut and its mating part.

CAUTION: DO NOT EXCEED 4200 LB.IN. TORQUE.

(d) Turn nut through an angle of 20 to 24 degrees. Record torque value.

(e) Loosen nut to 0 lb.in. and repeat step (b).

(f) If the nut reference point is in line with the mating part reference point, or beyond it within 3° maximum, apply final angle of turn per step (d).

(g) If the reference points are not within limits, repeat steps (c), (d) and (e) in order until reference points are within limits, then perform step (f).

(13) **Follow procedures in this step if optional hydraulic tool method was used to apply seating load to the HP turbine (Ref. step (9)):** operate wrench and tighten locknut per REF. NO. 1709, Table 203).

NOTE: When the specified torque is reached, the reading may drop rapidly. Maintain torque until reading has stabilized for one minute.

(14) Remove tools and install blanking plug (PWC31511) in HP turbine shaft.

(15) Install spacers (PWC31084) between small exit duct (SED) and large exit duct (LED) to load SED in running position.

CAUTION: DO NOT LUBRICATE THREADS WHICH ENGAGE LP COMPRESSOR SHAFT. CRIMPER THREADS MUST BE CLEAN AND DRY.

(16) Check HP turbine blade tip clearance (REF. NO. 1086, Table 202). If satisfactory, remove blanking plug (PWC31511) and crimp lockwasher (1) using locking tool (PWC31737). Install shaft blanking plug (PWC31511).

NOTE: Measure HP turbine blade tip clearance at blade leading edge.

(17) Install assembled fuel manifold system, combustion chamber liner, and low pressure turbine stator support assembly (Ref. 72-40-01).

(18) Install LP turbine rotor balancing assembly (Ref. 72-50-03).

(19) Install second-stage LP turbine stator assembly (Ref. 72-50-04).

(20) Install turbine exhaust duct and No. 4 bearing housing assembly (Ref. 72-50-06).

6. Procedure for Installing Replacement High Pressure Turbine

A. Establish Trim Balance Weight Configuration for Replacement Turbine

(1) Engine balancing procedures may require that during assembly, high pressure turbine rotor balance be obtained by making trim balance adjustments, thus rendering each high pressure turbine unique to the engine in which it is installed. The following special assembly techniques may therefore be necessary for field installation of a replacement high pressure turbine.

(2) Determine location and class of trim balance counterweights by referring to engine trim data plate (located on accessory gearbox), then cross-refer to code identification in Figure 203. If a reference cannot be found on trim data plate, a check must be made in engine log book; if there is no reference in engine log book, the replacement turbine may be installed as received.

NOTE: 1. Trim balance adjustments are made at initial assembly by addition of trim balance counterweights to high pressure turbine disk. The current method of balancing requires that these counterweights are added (as pairs) to front and rear balance rims of disk.

NOTE: 2. Some engines may not require trim balance adjustment. In such instances the trim data plate or log book entry will read NR (not required).

NOTE: 3. It may occur that balanced replacement assembly has detail balance weight(s) occupying location where trim balance weight(s) is/are installed. If this occurs, assembly must be returned for relocation of the detail balance weight(s) to ensure required location(s) for trim balance weight(s) is/are free (i.e. splitting) of detail weight(s).

(3) Perform trim balancing operation (if required) as follows (Ref. Figs. 201 and 203):

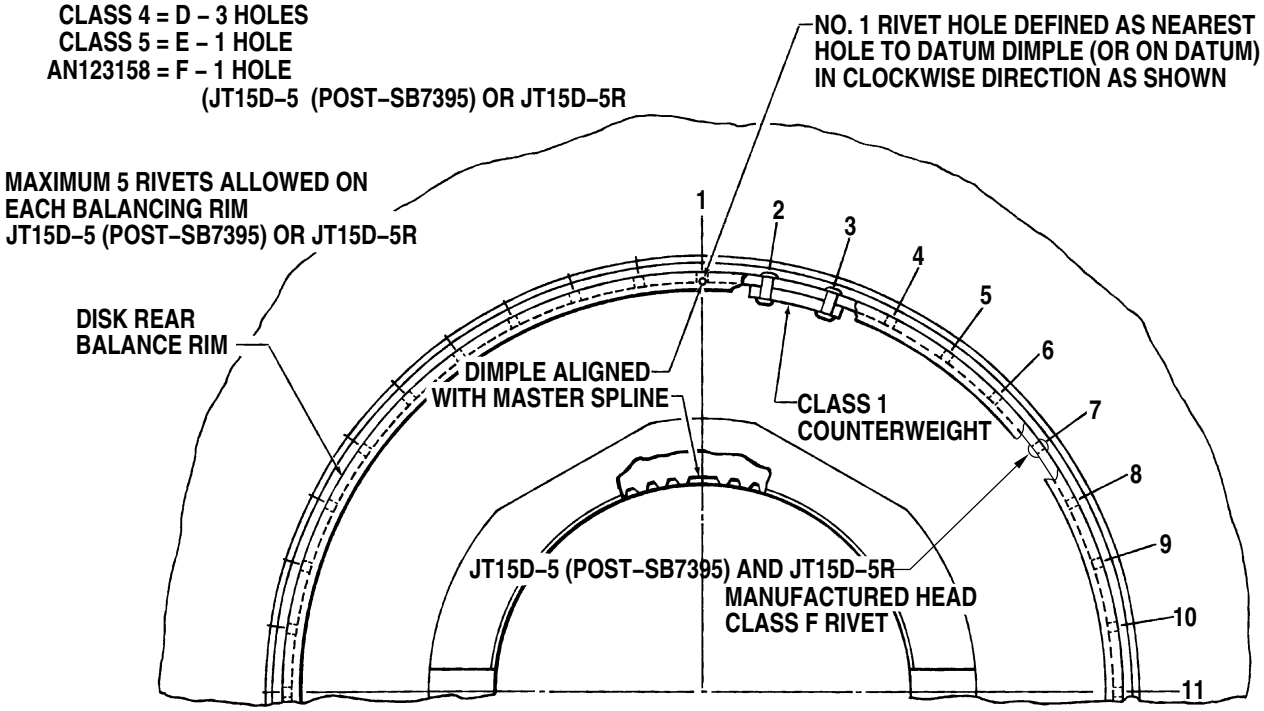
NOTE: SAMPLE TRIM BALANCE VALUE RECORDED ON ENGINE TRIM PLATE FOR THESE VIEWS

H	FA2	FF7		
H	RA2	RF7		

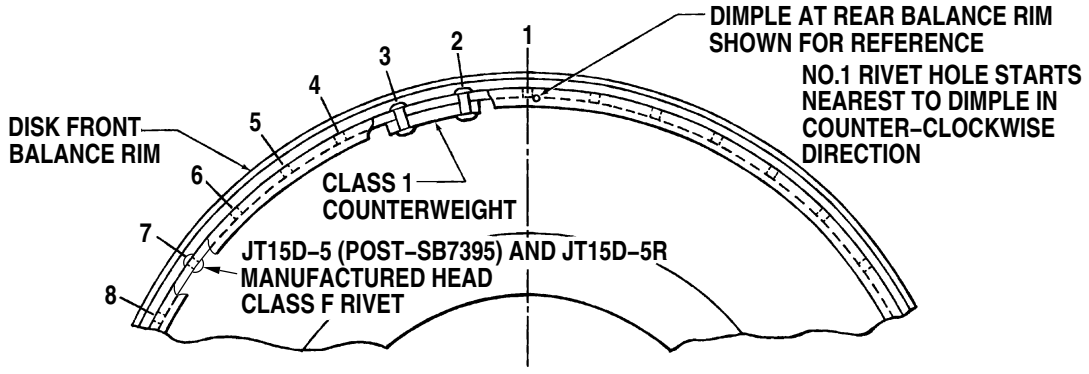
CODE H – DENOTES HIGH ROTOR TRIM BALANCE
R – DENOTES TURBINE REAR FACE
F – DENOTES TURBINE FRONT FACE
A – DENOTES COUNTERWEIGHT CLASS
2 – DENOTES FIRST RIVET HOLE OCCUPIED BY COUNTERWEIGHT IN DIRECTION OF COUNTING

NOTE: IDENTIFY COUNTERWEIGHTS AS FOLLOWS:

CLASS 1 = A – 2 HOLES
CLASS 2 = B – 2 HOLES
CLASS 3 = C – 3 HOLES
CLASS 4 = D – 3 HOLES
CLASS 5 = E – 1 HOLE
AN123158 = F – 1 HOLE
(JT15D–5 (POST–SB7395) OR JT15D–5R



VIEW ON REAR FACE OF HIGH TURBINE DISK



VIEW ON FRONT FACE OF HIGH TURBINE DISK

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High Pressure Turbine Trim Balance Coding - Front and Rear Balance Rim Application
Figure 203

(a) From recorded data, confirm trim balance counterweights (6, Fig. 201) on reject turbine disk (4). Remove these counterweights, using a flat chisel to cut off rivet (7) heads on outside diameter of front and rear balance rim. Drive out rivet stems, using a 0.062 inch diameter pin punch.

(b) Install previously removed trim balance counterweights (6) in recorded positions, as determined at step (2) preceding, on balancing rim of replacement turbine disk (4). Ensure that any asymmetrical counterweights are installed in the same attitude as removed. Secure counterweights with rivets inserted from inside diameters. Upset rivets, using riveter (PWC31687) and rivet sets (PWC30304-10) and (PWC30304-09).

B. Determine HP Turbine Positioning Spacer Dimension as follows (Ref. Fig. 204):

CAUTION: THIS PROCEDURE IS ALSO REQUIRED IF A NEW OR REPLACEMENT HP TURBINE STATOR OR HP TURBINE SPACER ARE TO BE INSTALLED.

(1) Measure distance from front face of HP turbine disk assembly (1), as shown, to installed No. 3 bearing rotor air seal (2) end face, to obtain dimension A.

(2) Measure distance from rear face of No. 3 bearing inner race (4) to a point established by vertical line from edge of stator inner vane ring (3), as shown, to obtain dimension B.

(3) Spacer thickness is obtained by formula:

(a) (Dim. B + 0.095 ± 0.005) - Dim. A = spacer thickness.

(4) Change and/or grind spacer, if necessary, to obtain required dimension (REF. NO. 1325, Table 202), with No. 2 bearing inner race (5) loaded in direction shown. After grinding, check spacer in four places; faces must be parallel within 0.0002 inch.

C. Installation Procedure

(1) Install HP turbine assembly in accordance with Paragraph 5.B..

7. Inspection/Check

A. Procedure

(1) Visually inspect HP turbine for condition and coating loss.

(2) Inspect HP turbine rotor blades (Ref. Table 201 and Fig. 205).

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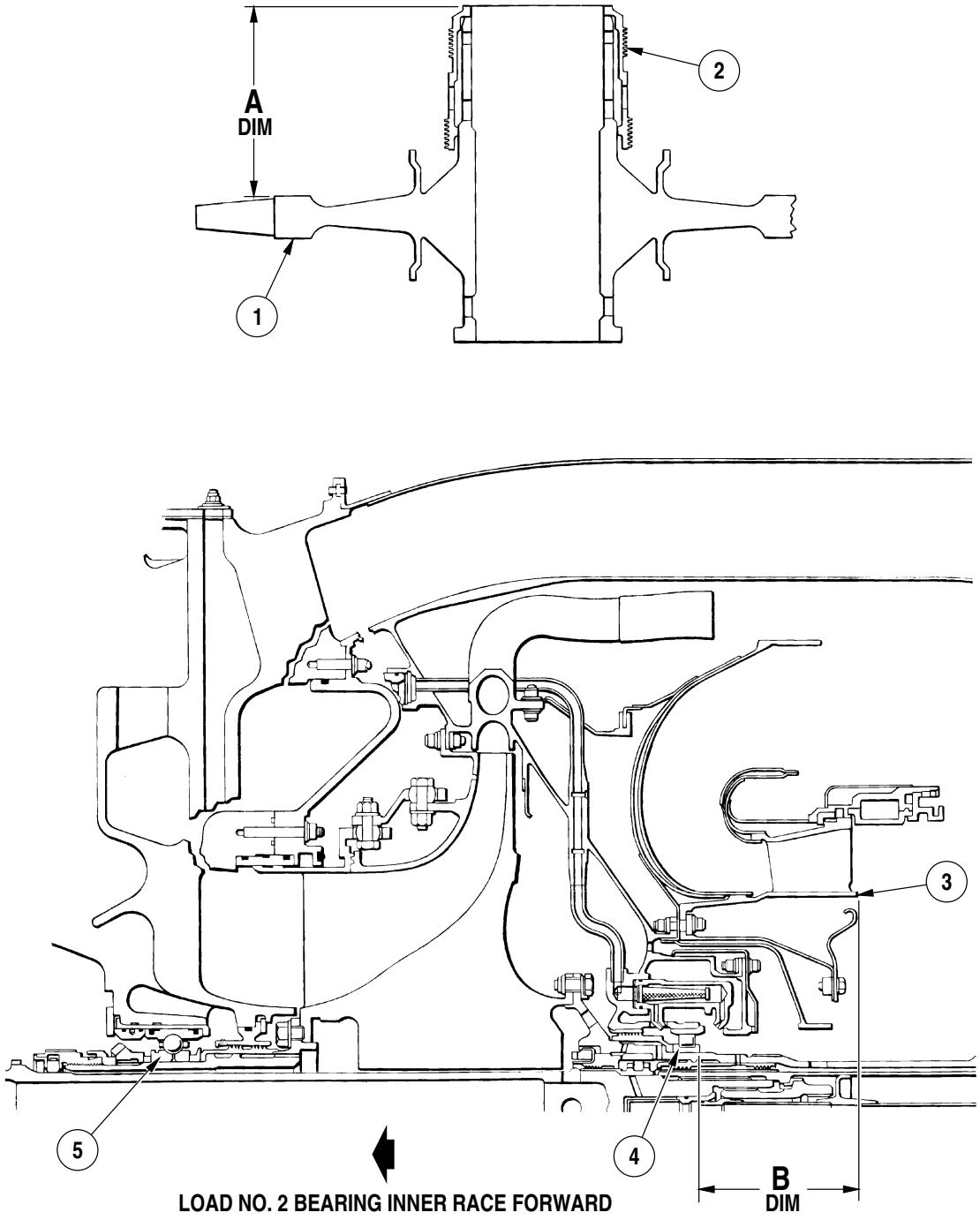

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Dimensioning of High Pressure Turbine Spacer
Figure 204

Key to Figure 204

1. High Pressure Turbine Disk Assembly
2. No. 3 Bearing Rotor Air Seal
3. High Pressure Turbine Stator Inner Vane Ring
4. No. 3 Bearing Inner Race
5. No. 2 Bearing Inner Race

TABLE 201, HP Turbine Blade Inspection

Inspection	Maximum Serviceable	Maximum Repairable	Corrective Action
Blade Shift	JT15D-5 (Pre-SB7297 or Pre-SB7317) engines: if protrusion of blade root is between 0.010 and 0.020 inch on either side of disk rim, see corrective action.	Not repairable	Incorporate SB7317
Blade Shift	JT15D-5 (Post-SB7297 or Post-SB7317) or JT15D-5R enignes protrusion of blade root beyond disk rim must not exceed 0.020 inch on either side of disk.	Not repairable	*
Blade Tip Rub	Tip wear due to rub must leave visible evidence of the growth platform.	Not repairable	*
Area A			
Nicks, dents and pits	Three 0.005 inch deep	None	*
Cracks	Not acceptable	None	*
Area B			
Nicks, dents and pits	One 0.005 inch deep	None	*
Cracks	None	None	*
Leading and Trailing Edges			
Nicks, dents and pits	One 0.020 inch deep	None	*
Leading Edge Tip			
Erosion	Refer to Figure 205	0.125 inch radius	*
Cracks	Not acceptable	None	*

TABLE 201, HP Turbine Blade Inspection (Cont'd)

Inspection	Maximum Serviceable	Maximum Repairable	Corrective Action
Corrosion	Inspect blade airfoil surfaces for loss of coating and corrosion using 10 power magnification. Assess stage of deterioration and disposition as follows:		
	Initial Coating Deterioration		
	Evidenced by a slight color change of part of the coating area. May be rust colored or dark grey. Coating has deteriorated but not significantly. Blades with coating loss less than 15% are considered acceptable for further service.		
	Secondary Coating Deterioration		
	Evidenced by apparent rise of attacked coating over surrounding surface with small scattered blisters appearing in the coating. Corrosion of the base materials has commenced. Continued use is dependent on the time to next periodic inspection as well as anticipated rinse procedure and/or frequency changes.		
	Advanced Corrosion		*
	Evidenced by clusters of ruptured blisters exposing bare material. Blades should be removed from service.		
* Return bladed disk to an approved overhaul facility.			

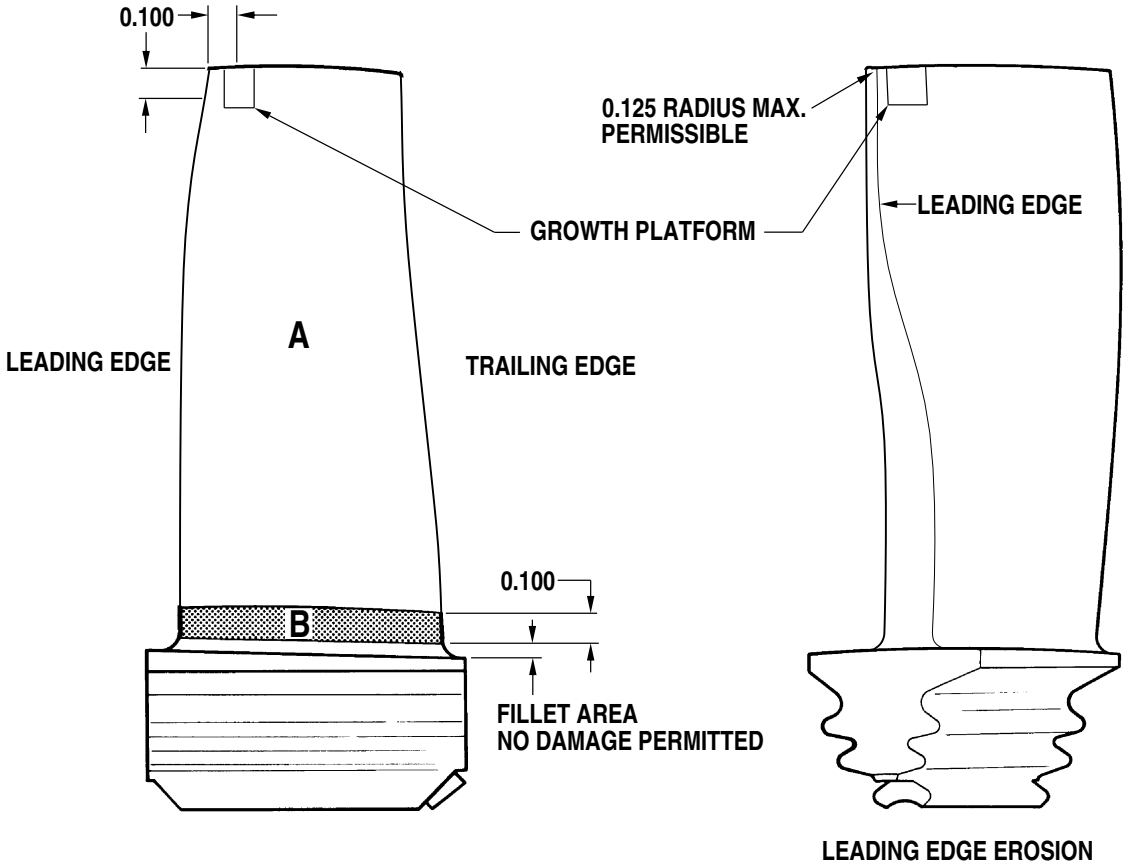
8. Approved Repairs (Heavy Maintenance Only)

   A. Procedure

      (1) Return HP turbine disk assembly to approved overhaul facility for repair.

9. Fits, Clearances and Torque Loadings

   A. Refer to Tables 202 and 203, and Figure 206.



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High Pressure Turbine Rotor Blade Inspection
Figure 205

TABLE 202, Fits and Clearances

REF. NO.	Name	Dim. for Ref. (inches) Min.	Dim. for Ref. (inches) Max.	Limits (inches) Min.	Limits (inches) Max.	Limits (inches) Replace
1059	Disk, High Pressure Turbine Rotor	2.7420	2.7430	0.0005	0.0025	
	Seal, Air, No. 3 Bearing Rear Rotor	2.7435	2.7445			
1061	Seal, Air, No. 3 Bearing Rear Rotor	3.1250	3.1265	0.0060	0.0080	
	Seal, Air, No. 3 Bearing Stator	3.1325	3.1330			
1065	Shaft, High Pressure Turbine	2.3500	2.3505	0.0015T	0.0030T	0.0010T
	Disk, High Pressure Turbine Rotor	2.3475	2.3485			
1067	Seal, Air, No. 3 Bearing Rear Rotor	3.2900	3.2920			
	Seal, Air, High Pressure Turbine, Assembly of	3.3005	3.3025	0.0085	0.0125	0.0170
1071	Shaft, High Pressure Turbine	0.0451	0.0471	0.0020	0.0060	
	Disk, High Pressure Turbine Rotor	0.0491	0.0511			
1072	Disk, High Pressure Turbine Rotor	2.7390	2.7400	0.0005T	0.0025T	
	Seal, Air, No. 3 Bearing Rear Rotor	2.7375	2.7385			
1082	Disk, High Pressure Turbine Rotor	4.4980	4.5020	0.0550 RADIAL	0.0600 RADIAL	
	Seal Assembly, Air, High Pressure Turbine	4.6120	4.6180			
1086	HP Turbine Blade, Radial Tip Clearance			0.028 (NEW SHROUD SEGMENTS)	0.033 (NEW SHROUD SEGMENTS)	

TABLE 202, Fits and Clearances (Cont'd)

REF. NO.	Name	Dim. for Ref. (inches) Min.	Dim. for Ref. (inches) Max.	Limits (inches) Min.	Limits (inches) Max.	Limits (inches) Replace
				0.020 (ENGINE-RUN SHROUD SEGMENTS: FIVE MINUTES TAKEOFF POWER MINIMUM)	0.033	
1089	Shaft, High Pressure Turbine	2.1800	2.1805	0.0015T	0.0030T	0.0010T
	Disk, High Pressure Turbine Rotor	2.1775	2.1785			
1325	Spacer, HP Turbine Positioning (Fit to)			0.0900	0.1000	

TABLE 203, Torque and Stretch

REF. NO.	Name	Limits Min.	Limits Max.
1709	JT15D-5 (Post-SB7513) and JT15D-5R: Locking Nut - HP Turbine Disk		

NOTE: Prior to each tightening of the nut, wipe clean and re-apply anti-seize compound (PWC06-009) to the nut threads, the shaft threads, the nut thrust face and its mating face.

(1) Tighten nut to 300 lb.in.

(2) Establish common reference points between the nut and its mating part.

CAUTION: DO NOT EXCEED 4200 LB.IN. TORQUE.

(3) Turn nut through an angle of 20 to 24 degrees. Record torque value.

(4) Loosen nut to 0 lb.in. and repeat step. Repeat step (1).

(5) If the nut reference point is in line with the mating part reference point, or beyond it within 3° maximum, apply final angle of turn per step (3).

(6) If the reference points are not within limits, repeat steps (2), (3) and (4) in order until reference points are within limits, then perform step (5).

TABLE 204, Spring Pressure

REF. NO.	Name	Limits Min.	Limits Max.
	Not Applicable		

TABLE 205, Special Assembly

REF. NO.	Name	Limits Min.	Limits Max.
1934	HP Disk Assembly on HP Compressor Rear Shaft		
	(1) Install HP disk assembly on HP compressor rear shaft.		
	(2) Apply an axial load of 13500 to 14500 lbf (4900 to 5250 psi).		
	NOTE: The load-to-psi conversion is derived from the cylinder effective area of the approved hydraulic cylinder (PWC89837).		
	(3) Maintain load until part cools to room temperature.		
	(4) Remove axial load.		

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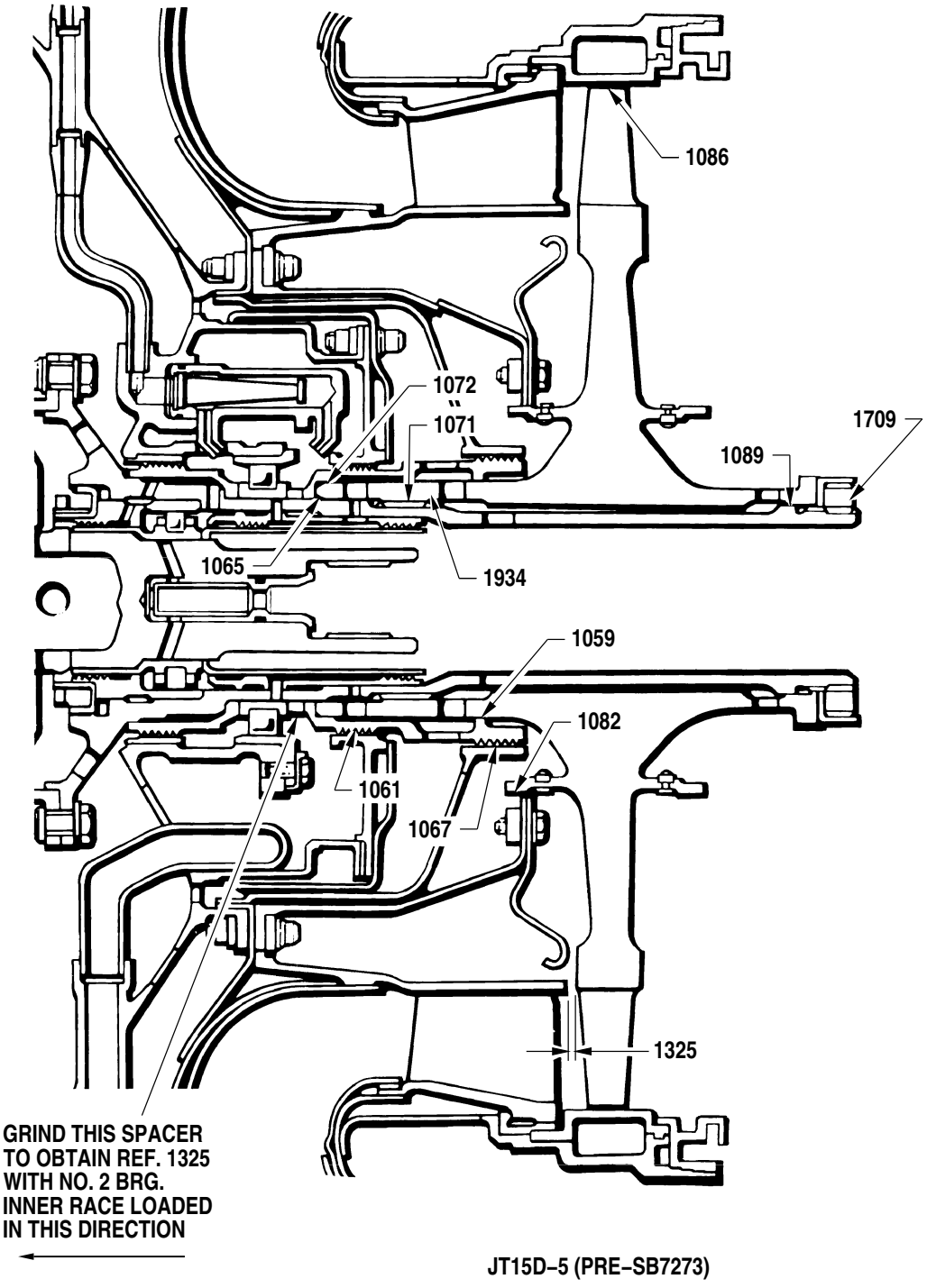

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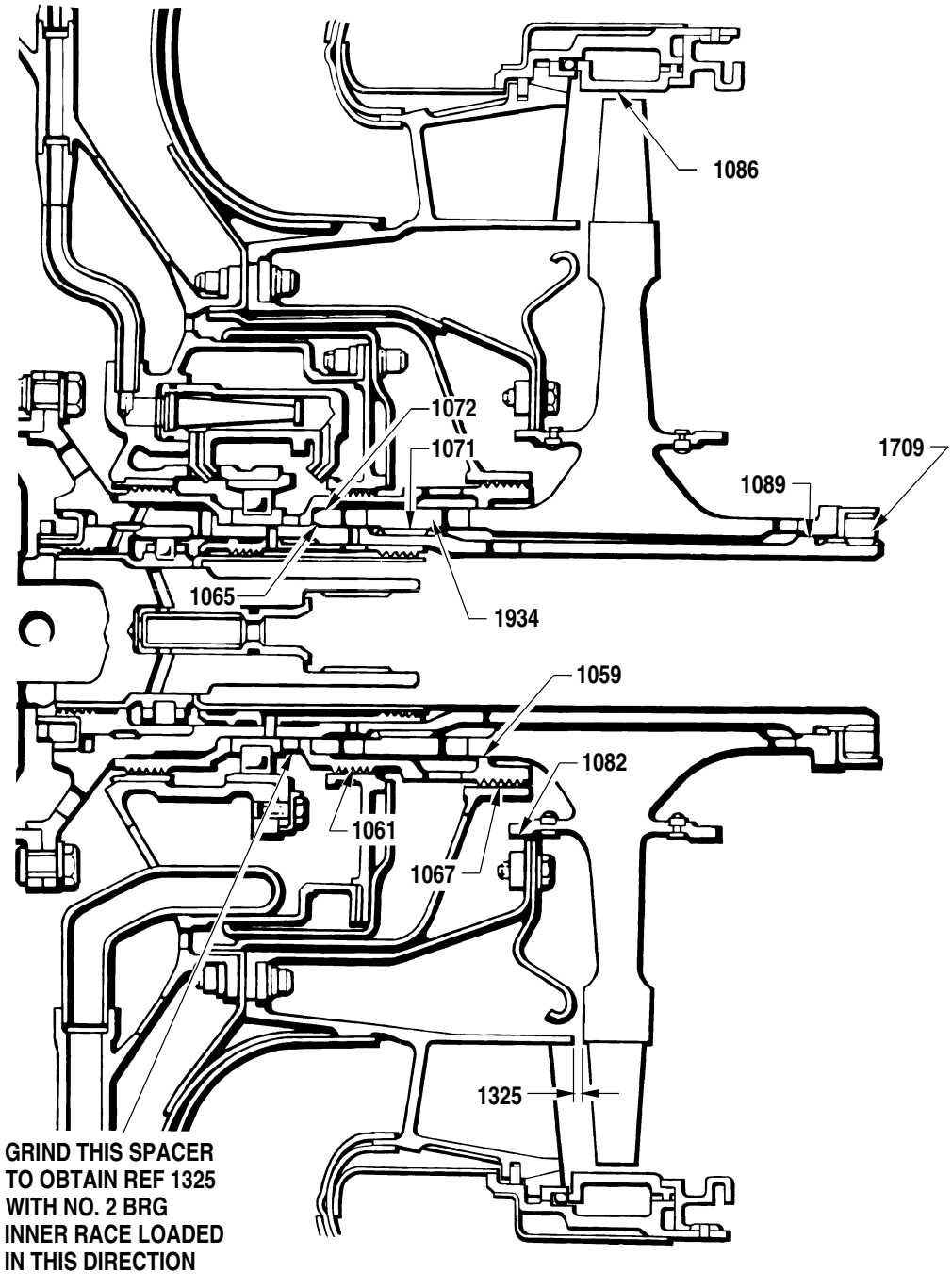
Fits, Clearances and Torque Loadings
Figure 206 (Sheet 1 of 2)



JT15D–5 (POST–SB7273) SHOWN
JT15D–5R SIMILAR

C21273D

Fits, Clearances and Torque Loadings
Figure 206 (Sheet 2)

LP TURBINE ROTOR BALANCING ASSEMBLY - DESCRIPTION AND OPERATION

1. Description (Ref. Fig. 1)

The LP turbine rotor balancing assembly consists of the LP turbine shaft assembly and two turbines with associated hardware, stacked from the rear in the following order: No. 4 bearing, air seal, LP turbine disk balancing assembly, air seal, LP turbine rotor, air seal, lockwasher and round nut. The rear shaft houses an intershaft oil transfer tube assembly, the forward end of which passes through the turbine shaft hollow locking bolt. The other end of the transfer tube is located by an integral support which abuts a shoulder in the bore of the turbine shaft at the rear. A retaining ring secures the tube. The hollow support extends into the No. 4 bearing housing cover where its outer diameter rotates within a carbon seal to restrict oil leakage into the bearing housing cavity. The sealing diameter of the support has an end chamfer to facilitate assembly. A second support at the transfer tube center prevents deflection.

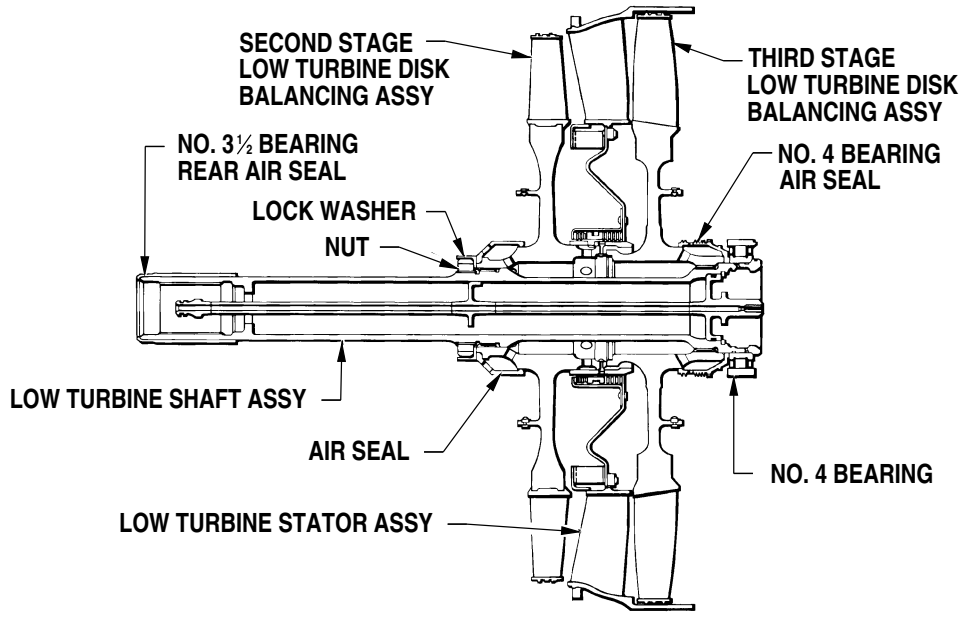
The interstage baffle and stator assembly is supported between the turbines. The baffle assembly prevents dissipation of gas heat to the faces of the turbine disks and incorporates a flexible air seal which prevents ingestion of hot gases.

Torque developed by the gas flow through the LP turbines is transmitted to the LP turbine shaft through splines at the front of the second-stage turbine disk and splines at the rear of the third-stage turbine disk. The rotor assembly is built and balanced in two planes by adding, if necessary, a limited number of balance weights and rivets to the front balance rim of the second-stage turbine disk, and the rear balance rim of the third-stage turbine disk, or both.

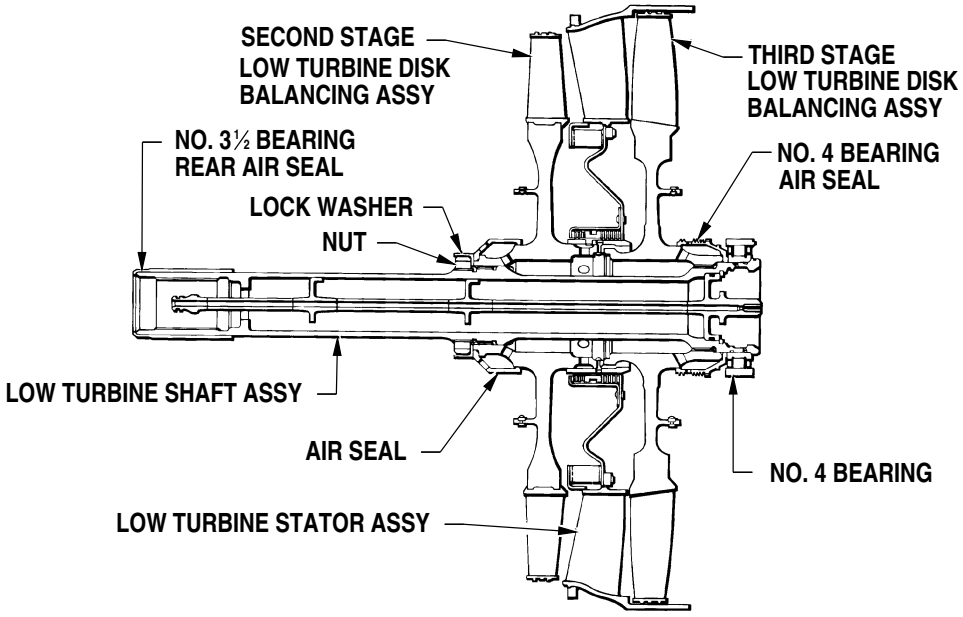
The second-stage turbine disk assembly consists of a nickel alloy disk with fir-tree serrations machined in the outer circumference. The serrations mount 61 blades with integral tip shrouds forming a continuous ring. The blades are retained in the disk by individual rivets. A machined front balancing rim mounts the balancing counterweights and rivets.

The LP turbine interstage stator assembly consists of a cast cobalt alloy vane ring, and a concentric nickel alloy turbine interstage baffle assembly. The stator comprises 43 vanes, and its outer platform extended to the rear, forms a shroud for the second LP turbine stage (LP turbine disk balancing assembly). The front of the outer platform has 12 equally spaced locating lugs which fit into slots of the turbine stator support assembly. The baffle assembly incorporates an air seal stack at its inner circumference.

The third-stage turbine disk balancing assembly consists of a nickel alloy disk with fir-tree serrations machined in the outer circumference. The serrations mount 55 blades with integral tip shrouds forming a continuous ring. The blades are retained in the disk by individual rivets. A machined rear balancing rim mounts the balancing counterweights and rivets.



JT15D–5 (PRE–SB7223) ENGINES



JT15–5 (POST–SB7223) ENGINES

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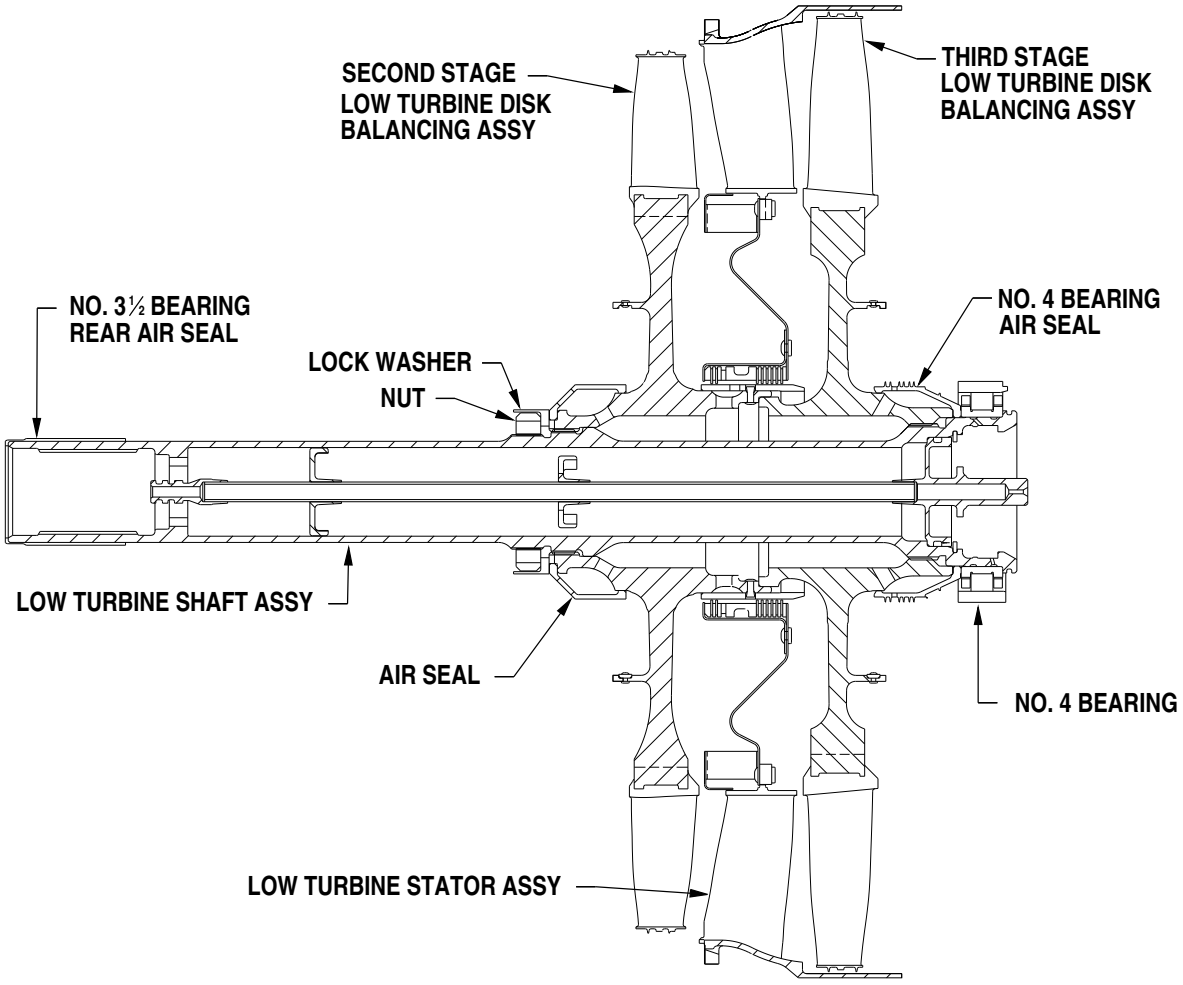
LP Turbine Rotor Balancing Assembly
Figure 1 (Sheet 1 of 2)



**JT15D–5 (POST–SB7452)
AND JT15D–5R ENGINES**

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LP Turbine Rotor Balancing Assembly
Figure 1 (Sheet 2)

LP TURBINE ROTOR - MAINTENANCE PRACTICES

1. General

A. The following are the maintenance practices for the LP turbine rotor balancing assembly.

2. Consumable Materials

The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Engine Lubricating Oil
PWC05-018	Metal Marking Crayon
PWC05-103	Pencil Marker
PWC06-004	Anti-galling Paste
PWC11-056	Alkaline Carbon Remover

3. Special Tools

The special tools listed below are used in the following procedures.

Tool No.	Name	Application
PWC31016	Socket, LPT Shaft Locking Bolt	
PWC31018	Stand	
PWC31046	Adapter, LPT Shaft	Use with Torque Wrench PWC31050
PWC31050	Torque Wrench	
PWC31077	Extension Bar	Use with Torque Wrench PWC31050
PWC31350	Puller, LPT Rotor Assembly	
PWC31374	Crimper, LPT Shaft Locking Bolt Cupwasher	
PWC31369	Spreader, LPT Shaft Locking Bolt Cupwasher	
PWC31511	Blanking Plug, HPT Shaft	
PWC31546	Adapter	Use with Torque Wrench PWC41050
PWC31577	Extension Bar	Use with Torque Wrench PWC41050
PWC31651	Adapter, LPC Shaft	
PWC31664	Puller, No. 3½ Brg. Transfer Tube	

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Tool No.	Name	Application
PWC32507	Hydraulic Pump	
PWC41050	Torque Wrench	
PWC52357	Puller/Pusher, Extension Ferrule	Post-SB7452
PWC52619	DELETED	Replaced by PWC52820
PWC52820	Pusher	Replaces PWC52619
PWC89837	Hydraulic Cylinder	Replaces PWC32506

4. Fixtures, Equipment and Supplier Tools

Not Applicable

5. Removal/Installation (Heavy Maintenance Only)

A. Removal of LP Turbine Rotor Balancing and LP Turbine Stator Assemblies (Ref. Fig. 201)

(1) Remove turbine exhaust duct and No.4 bearing housing assembly (Ref. 72-50-06).

WARNING: POSSIBLE PRESSURE BUILD UP IN LOW TURBINE SHAFT. EXERCISE CARE WHEN REMOVING THE RETAINING RING.

(2) Hold end of intershaft oil transfer tube assembly (7) and remove retaining ring (5).

CAUTION: EXERCISE CARE TO AVOID DAMAGE TO CARBON SEAL JOURNAL WHEN PULLING THE INTERSHAFT OIL TRANSFER TUBE ASSEMBLY.

(3) Using a metal marking crayon (PWC05-018), mark position of intershaft oil transfer tube assembly (7), relative to LP turbine shaft for reference at assembly. Using puller (PWC31664), remove oil transfer tube from LP turbine shaft (12). Remove and discard preformed packings (6) and (8).

(4) Clean transfer tube (7) (Ref. Para.7.).

(5) Unlock keywasher (3) using spreader (PWC31369).

(6) For (PWC31050) wrench: install adapter (PWC31046) on LP turbine shaft. Install socket (PWC31016) on extension bar (PWC31077) and engage in shaft locking bolt (4). Install and operate wrench (PWC31050) to loosen bolt. Remove tools, bolt (4) and keywasher (3). Discard keywasher. Discard Pre-SB7315 configuration shaft locking bolt. Retain other configurations of shaft locking bolt.

(7) For (PWC41050) wrench: Install adapter (PWC31546) on LP turbine shaft. Install socket (PWC31016) on extension bar (PWC31577) and engage on shaft locking bolt (4). Install and operate and wrench (PWC41050) to loosen bolt (4). Remove tools, bolt (4) and keywasher (3). Discard keywasher. For JT15D-5 engines: Discard Pre-SB7315 configuration shaft locking bolt. Retain other configurations of shaft locking bolt.

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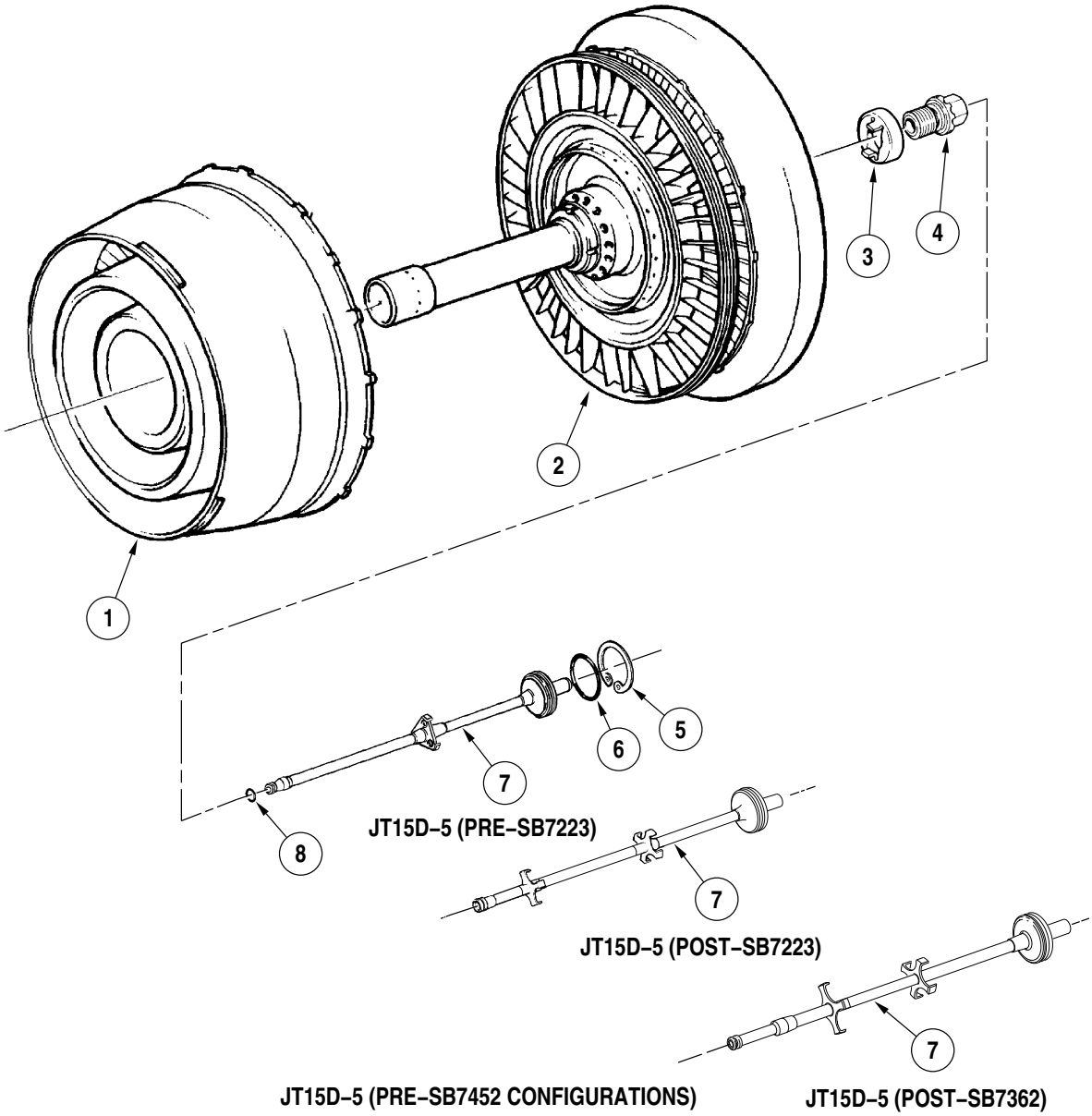

C39342B

Removal/Installation - LP Turbine Rotor Balancing Assembly
Figure 201 (Sheet 1 of 3)

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Key to Figure 201

1. LP Turbine Stator Assembly
2. LP Turbine Rotor Balancing Assembly
3. Key Washer
4. Turbine Shaft Hollow Locking Bolt
5. Retaining Ring
6. Preformed Packing
7. Intershaft Oil Tube Assembly
8. Preformed Packing
9. Extension Ferrule
10. Preformed Packing
11. No. 3½ Bearing Oil Strainer
12. LP Turbine Shaft
13. LP Compressor Shaft

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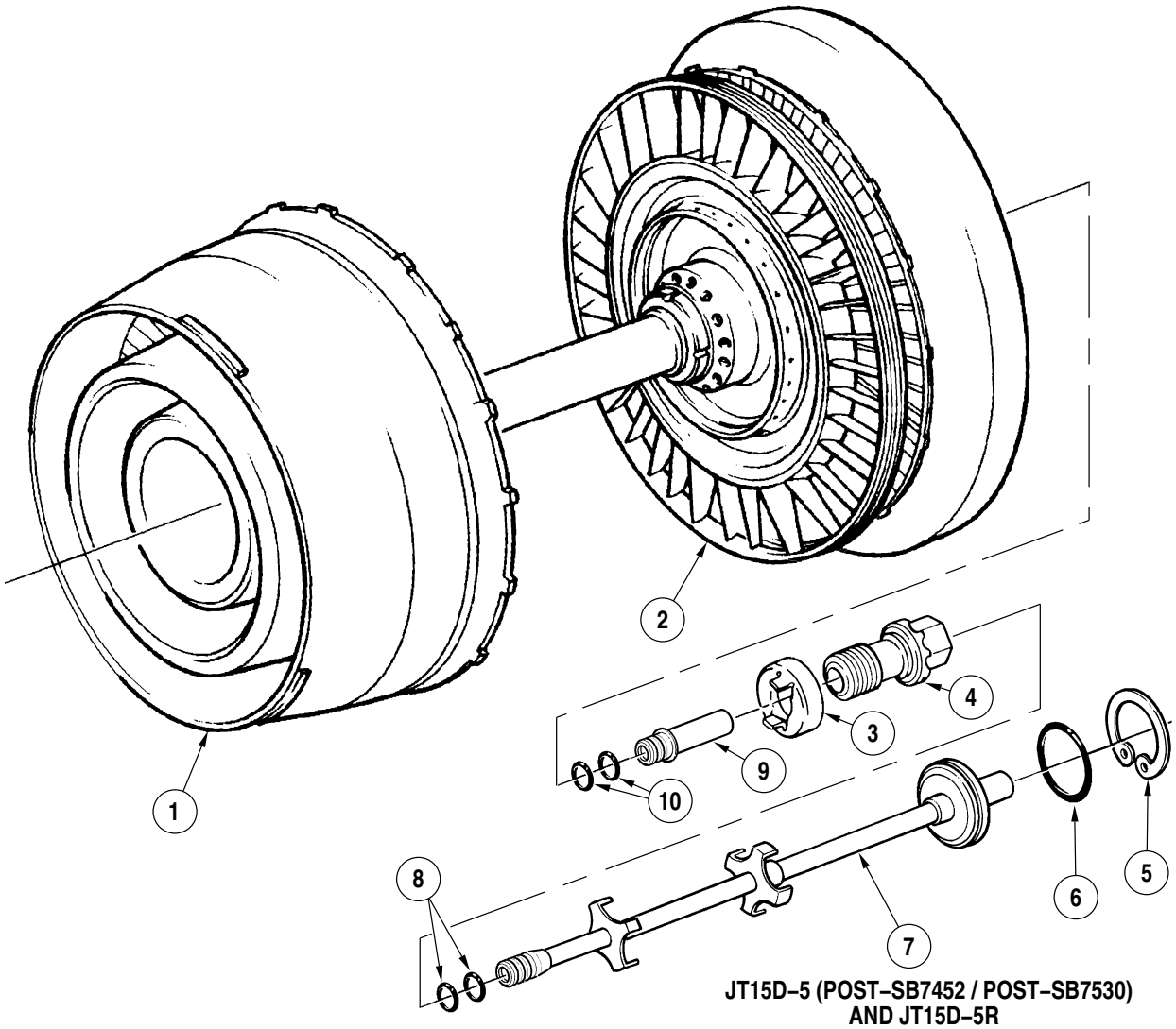
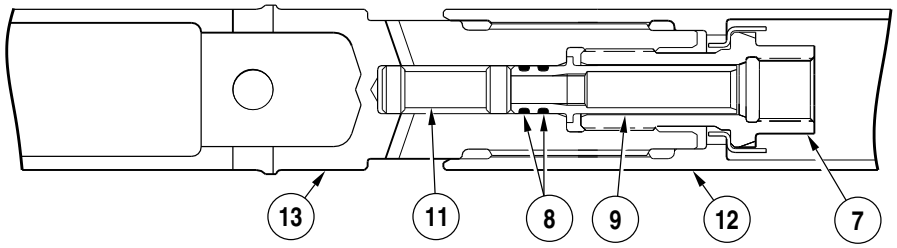


JT15D–5 (POST–SB7452 / POST–SB7530)
AND JT15D–5R



DETAIL **A** (SHOWN WITHOUT TRANSFER TUBE)
JT15D–5 (POST–SB7452) AND JT15D–5R

C39340G

Removal/Installation - LP Turbine Rotor Balancing Assembly
Figure 201 (Sheet 2)

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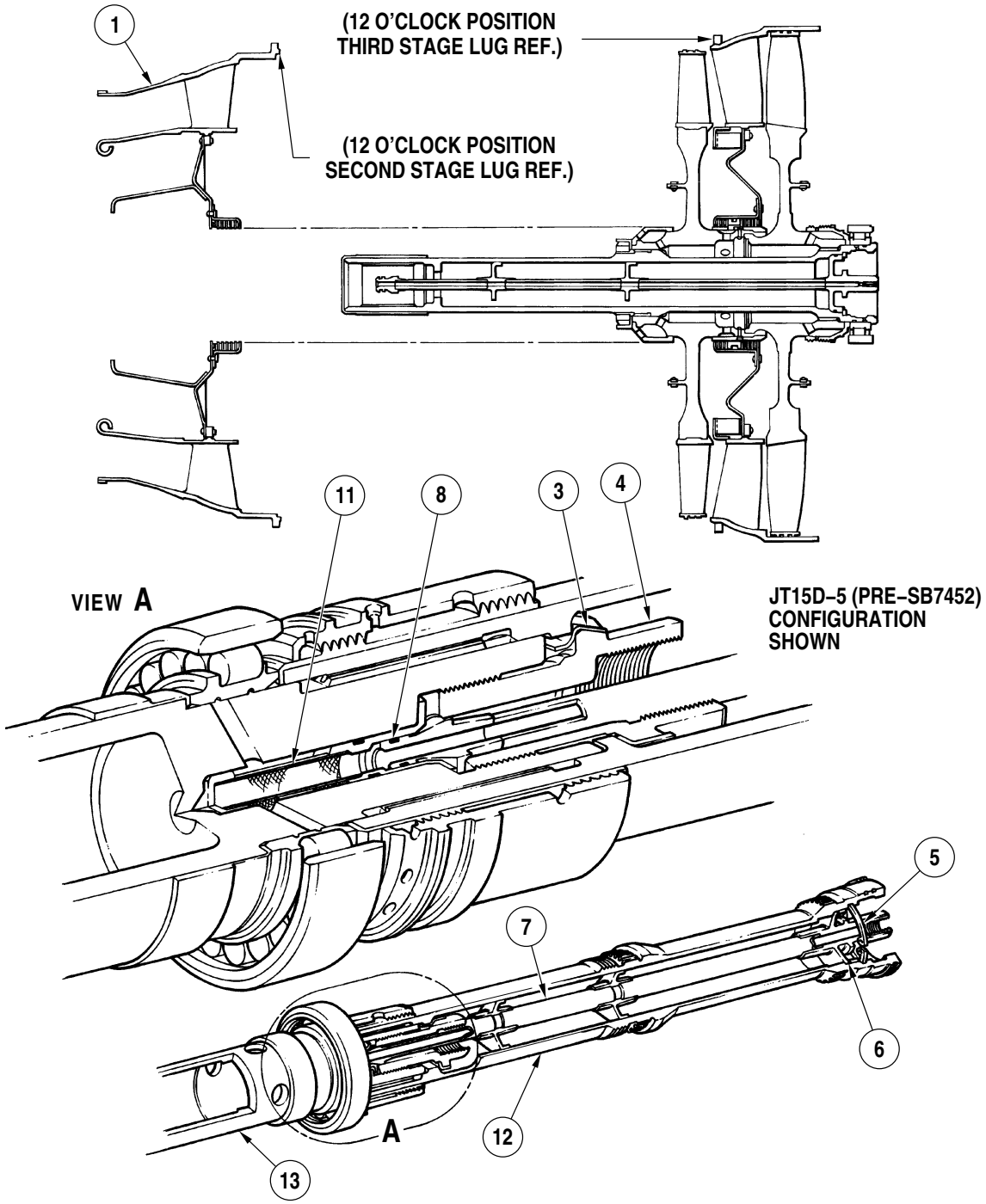

C17490C

Removal/Installation - LP Turbine Rotor Balancing Assembly
Figure 201 (Sheet 3)

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(8) For JT15D-5 Post-SB7452 and JT15D-5R engines: remove extension ferrule (9) using puller (PWC52357) to permit installation of adapter (PWC31651). Remove and discard two preformed packings (10).

CAUTION: DO NOT LUBRICATE ADAPTER THREADS: ADAPTER AND LP COMPRESSOR SHAFT THREADS MUST BE CLEAN AND DRY.

(9) Install and tighten adapter (PWC31651) into LP compressor shaft and attach puller (PWC31350) in groove at end of turbine shaft.

(10) Before removing LP turbine rotor assembly, complete the following procedures for reference at installation:

(a) Measure and record axial dimension from rear face of LP stator support to rear face of third-stage stator vane ring.

(b) Rotate fan so that inlet cone balance V-mark is at 12 o'clock position. Using pencil marker (PWC05-103), align LP compressor blade, LP turbine blade and third stage stator by putting index marks on each component.

(11) Operate puller (PWC31350) and release LP turbine from LP compressor shaft. Remove puller and adapter (PWC31651).

NOTE: Puller (PWC31350) can be used to remove LP turbine rotor from engine.

CAUTION: INSTALL BLANKING PLUG (PWC31511) INTO HIGH PRESSURE TURBINE SHAFT, IMMEDIATELY FOLLOWING REMOVAL OF LP TURBINE ROTOR BALANCING ASSEMBLY, TO PROTECT NO. 3-½ BEARING AND SURROUNDING AREA.

(12) Carefully remove LP rotor turbine assembly from engine and secure on stand (PWC31018).

NOTE: It is not required to remove the No. 3-½ bearing oil strainer (11), located in bore at rear of compressor shaft, at Hot Section Inspection.

(13) Remove second-stage LP turbine stator assembly (1). Identify lug in 12 o'clock position of second-stage stator vane ring for subsequent reassembly, using temporary marking method (Ref. 70-00-00, MAINTENANCE PRACTICES, Marking Methods).

B. Installation of LP Turbine Rotor Balancing Assembly and LP Turbine Stator Assembly (Ref. Fig. 201)

(1) Install second-stage LP turbine stator assembly (1) with appropriate lug in 12 o'clock position and other lugs properly located in slots of LP turbine stator support assembly. Check to ensure that no axial gap exists between support lugs and three locating faces of LP turbine stator support assembly.

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CAUTION: TAKE EXTREME CARE TO AVOID DAMAGE TO EXPOSED NO.4 BEARING: AVOID HANDLING BEARING.

(2) While LP turbine rotor balancing assembly is on stand (PWC31018), install only main body of puller (PWC31350) as a support tool. Position tool so that appropriate lug on third-stage stator vane ring will be in 12 o'clock position.

(3) Heat the two forward (LPC shaft mating) inside diameters of the LPT shaft using an appropriate heat gun for five minutes maximum.

(4) Remove blanking plug (PWC31511) from high pressure turbine shaft.

(5) Verify that No. 3½ bearing oil strainer (11) is installed in rear bore of LP compressor shaft. If oil strainer fell out during LPT rotor removal, check that strainer is free from damage, then reinstall as follows:

(a) JT15D-5 (Pre-SB7452) engines: using mechanical fingers, install strainer (11) with strainer larger diameter to rear of engine.

(b) JT15D-5 (Post-SB7452) and JT15D-5R engines: using mechanical fingers, install strainer (11) with open, internally threaded end of strainer to rear of engine.

NOTE: Do not use pusher (PWC52357) to install strainer.

CAUTION: DO NOT USE LUBRICATING OIL ON SPLINES OF LP TURBINE SHAFT.

(6) Remove heat gun and install the LPT rotor immediately. Put index-marked LP compressor blade at 12 o'clock position. Align marked LP turbine blade with marked LP compressor blade, and slowly insert turbine assembly into engine, mating splines with outer splines of LP compressor shaft (13).

NOTE: Ensure inlet cone V mark and stator vane ring X mark are aligned at engine 12 o'clock position during mating of shaft.

(7) Locate lugs on outer circumference of stator assembly in slots of LP turbine stator support assembly. Remove puller (PWC31350).

NOTE: Strict compliance with steps (9) through (16), following, will ensure that LP turbine rotor balancing assembly is correcty seated and distortion of LP turbine shaft locking bolt keywasher has not occurred.

CAUTION: DO NOT LUBRICATE THE THREADS OF PUSHER (PWC52820).

(8) Optional procedure to load the LPT rotor assembly prior to tightening the shaft locking bolt as follows:

NOTE: The LPT rotor assembly may be installed with or without the use of hydraulic pre-loading equipment.

(a) Install pusher (PWC52820) through the bore of the LPT shaft and engage the LP compressor shaft threads. Tighten the pusher into the LPC shaft mating threads.

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(b) Attach hydraulic cylinder (PWC89837) and hydraulic pump (PWC32507) to the pusher. Operate the hydraulic pump and apply a load per procedure described in Table 203, REF. NO. 1721.

(c) Keep tools installed, maintain the load and allow 15 minutes minimum for the LPT shaft to cool. Remove tools after parts have cooled.

(9) With a metal marking crayon (PWC05-018), mark rear face of LP turbine shaft (12) in line with one keywasher-locating slot in shaft, then put a mark on the edge of a new keywasher (3) aligned to one of it's locking tangs.

(10) JT15D-5 (Post-SB7452) and JT15D-5R engines: install two new preformed packings (10) on extension ferrule (9).

(11) JT15D-5 (Post-SB7452) and JT15D-5R engines: install No.3½ bearing oil strainer (11). Install extension ferrule (9) using pusher (PWC52357).

CAUTION: DO NOT USE LUBRICATING OIL ON KEYWASHER. KEYWASHER SHOULD BE INSTALLED CLEAN AND DRY.

(12) Install new keywasher (3) in LP turbine shaft (12) so that ear on rear edge of keywasher (3) is aligned with mark on shaft (12). Ensure keywasher tangs are correctly located in shaft slots and that keywasher is properly seated.

CAUTION: DO NOT USE LUBRICATING OIL ON SHAFT BOLT. BOLT SHOULD BE INSTALLED CLEAN AND DRY.

CAUTION: ON JT15D-5 (POST-SB7315 AND POST-SB7452) and JT15D-5R SHAFT LOCKING BOLT, ANTI-GALLING COMPOUND MUST COVER 80 PERCENT OF BOLT THREADING.

(13) Install a serviceable shaft locking bolt (4) as follows:

(a) For (PWC31050) wrench: Install adapter (PWC31046) on LP turbine shaft. Install shaft locking bolt (4). Install socket (PWC31016) on extension bar (PWC31077) and engage on shaft locking bolt (4). Install wrench (PWC31050).

NOTE: Do not install a Pre-SB7315 shaft locking bolt.

(b) For wrench (PWC41050): Install adapter (PWC31546) on LP turbine shaft (12). Install shaft locking bolt (4). Install socket (PWC31016) on extension bar (PWC31577) and engage on shaft locking bolt (4). Install wrench (PWC41050).

NOTE: Do not install a Pre-SB7315 shaft locking bolt.

(14) **Follow the procedures in this step if no optional tools were used to apply a load to the LPT rotor assembly (Ref. step (8)):**

NOTE: When the specified torque is reached, the reading may drop rapidly at first. Maintain torque until reading has stabilized for one minute.

(a) Operate wrench and apply first torque to the turbine shaft locking bolt of 700 to 750 lb.in.

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(b) Operate wrench and loosen bolt to zero lb.in.

(c) Operate wrench and apply final torque to LPT shaft locking bolt of 350 to 400 lb.in.

(15) **Follow the procedure in this step if optional tools were used to apply seating load to the LPT rotor assembly (Ref. step (8)):** Operate wrench and torque shaft locking bolt (4) per REF. NO. 1721, Table 203.

NOTE: When the specified torque is reached, the reading may drop rapidly at first. Maintain torque until reading has stabilized for one minute.

(16) Remove all tools and check that mark on keywasher ear is still aligned with mark on LPT shaft (12). If mark is not aligned, loosen and remove the JT15D-5 (Post-SB7452) or JT15D-5R extension ferrule and JT15D-5 (Post-SB7452) or JT15D-5R oil strainer (if applicable), the LPT bolt (4) and keywasher (3) (Ref. Subpara. 5.A.). Discard the cupwasher. Repeat steps (9) through step (14) or step (15) as applicable, using a new keywasher (3).

NOTE: For JT15D-5 (Post-SB7452) and JT15D-5R engines, remove, discard and replace the two preformed packings (10) before reinstalling the extension ferrule.

(17) Recheck dimension recorded in Paragraph 5.A., step (10), preceding, to ensure low turbine stator is correctly seated.

(18) Crimp keywasher using locking tool (PWC31374). Remove locking tool.

(19) For JT15D-5 (Pre-SB7452)Pre-SB7452 engines: Make sure that the intershaft oil transfer tube (7) is internally clean and free from any blockage. Install one new preformed packing (8) on intershaft oil transfer tube assembly.

(20) For JT15D-5 (Post-SB7452) and JT15D-5R engines engines: verify that intershaft oil transfer tube (7) interior is clean and free from any obstructions. Install two new preformed packings (8) and one new preformed packing (6) on intershaft oil transfer tube assembly (7).

(21) Align etched V-marks on intershaft transfer tube (7) with etch mark on LP turbine shaft (12) and install tube. Align etch marks on retaining ring (5) with marks on shaft and transfer tube. Install retaining ring.

(22) Install turbine exhaust duct and No. 4 bearing housing assembly (Ref. 72-50-06).

6. Inspection/Check

A. Low Pressure Turbine Rotor Balancing Assembly

(1) Inspect rotor balancing assembly (Ref. Fig. 202 and Table 201).

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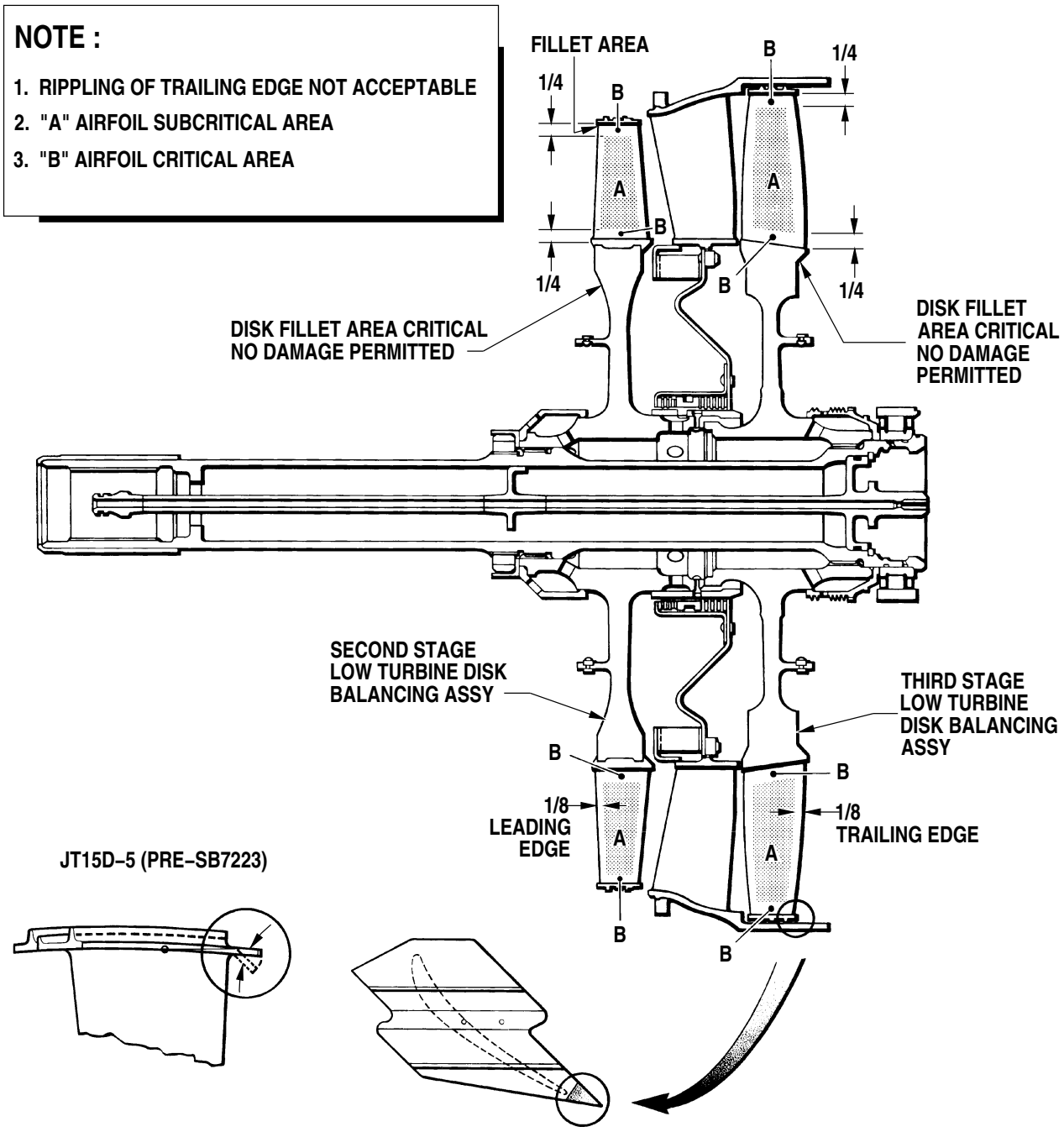

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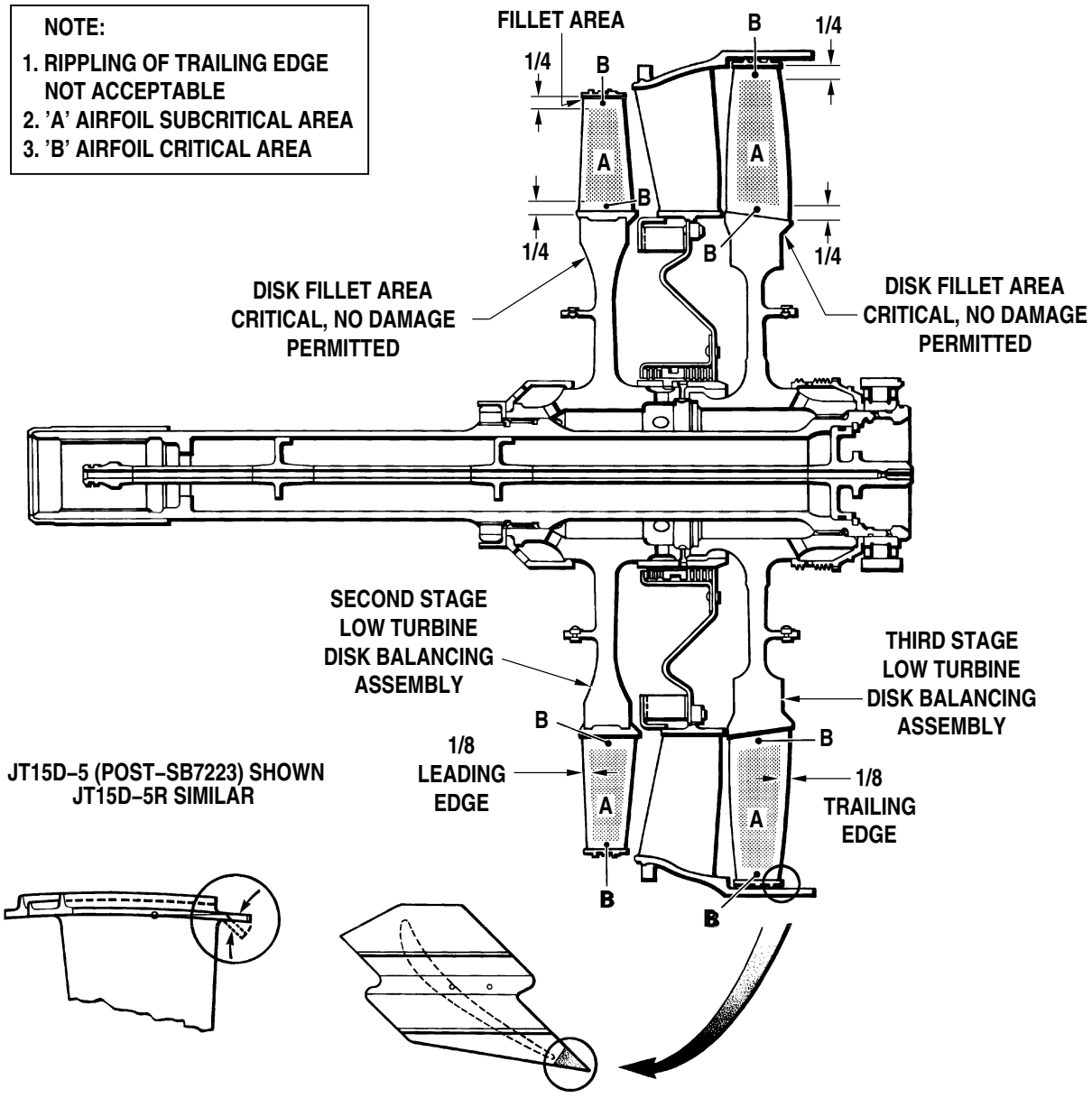
Low Pressure Turbine Rotor Balancing Assembly - Inspection
Figure 202 (Sheet 1 of 2)



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Low Pressure Turbine Rotor Balancing Assembly - Inspection
Figure 202 (Sheet 2)

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TABLE 201, Low Pressure Turbine Rotor Balancing Assembly Inspection

INSPECTION	MAXIMUM SERVICEABLE	MAXIMUM REPAIRABLE	CORRECTIVE ACTION
Second and Third-Stage Disk Balancing Assemblies			
Blade Shift	Protrusion of blade root beyond disk rim must not exceed 0.010 inch on either side of disk	Not repairable	Return second and third-stage disk balancing assembly to an approved overhaul facility.
Area A			
Nicks	Three 0.005 inch deep	Three 0.015 inch long by 0.005 inch deep	Blend
Dents and pits	Three 0.005 inch deep	Three 0.010 inch deep	Blend
Cracks	Not acceptable	None	Return second and third-stage disk balancing assembly to an approved overhaul facility.
Area B			
Nicks	One 0.010 inch deep	One 0.020 inch deep	Blend
Dents	One 0.010 inch deep	One 0.020 inch deep	Blend
Cracks	Not acceptable	None	Return second and third-stage disk balancing assembly to an approved overhaul facility.
Blade Leading and Trailing Edges			
Nicks	One 0.010 inch deep	One 0.020 inch deep	Blend
Dents	One 0.010 inch deep	One 0.020 inch deep	Blend
Cracks	Not acceptable	None	Return second and third-stage disk balancing assembly to an approved overhaul facility.
Third-Stage Disk Balancing Assembly	Bent tips acceptable provided crack or rub is not present		If crack or rub is present, remove material to eliminate . Blend sharp edges.

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TABLE 201, Low Pressure Turbine Rotor Balancing Assembly Inspection (Cont'd)

INSPECTION	MAXIMUM SERVICEABLE	MAXIMUM REPAIRABLE	CORRECTIVE ACTION
	Broken off tips acceptable		Blend sharp edges.

(2) Inspect stator assembly for condition.

B. LP Turbine Shaft

(1) Check inside diameter of low pressure turbine shaft for carbon buildup. Remove carbon buildup as detailed in Paragraph 7..

(2) Check bore of low turbine shaft for surface damage to coating and base material.

(a) Scoring in coating is acceptable without blending.

(b) Scoring in base material can be locally blended to depth of 0.010 inch.

(c) Fretting, pitting and corrosion can be accepted to a depth of 0.010 inch.

C. Intershaft Oil Transfer Tube (Ref. Fig. 203)

(1) Check bore of intershaft transfer tube for possible obstructions. Weld flow through in bore of the tube is acceptable up to 70 percent of cross section of bore. Clean tube (Ref. Para. 7.).

(2) Check intershaft transfer tube for stretch. Replace tube if beyond limits.

(3) Inspect transfer tube assembly for distortion as follows:

(a) JT15D-5 (Pre-SB7362) engines: with intershaft oil transfer tube supported at Dias. A and F, check tube circular runout as follows:

1 Circular runout at Dia. A must not exceed 0.002 inch FIR in relation to Dia. F.

2 Circular runout at Dia. B must not exceed 0.005 inch FIR in relation to Dias. A and F.

3 Circular runout at Dias . C must be exceed 0.003 inch FIR in relation to Dias. A and F.

4 Circular runout at Dias . D must not exceed 0.010 inch FIR in relation to Dias. A and F.

5 Circular runout at Dia. F must not exceed 0.002 inch FIR in relation to Dia. A.

6 Circular runout at Dia. G must not exceed 0.002 inch FIR in relation to Dias. A and F.

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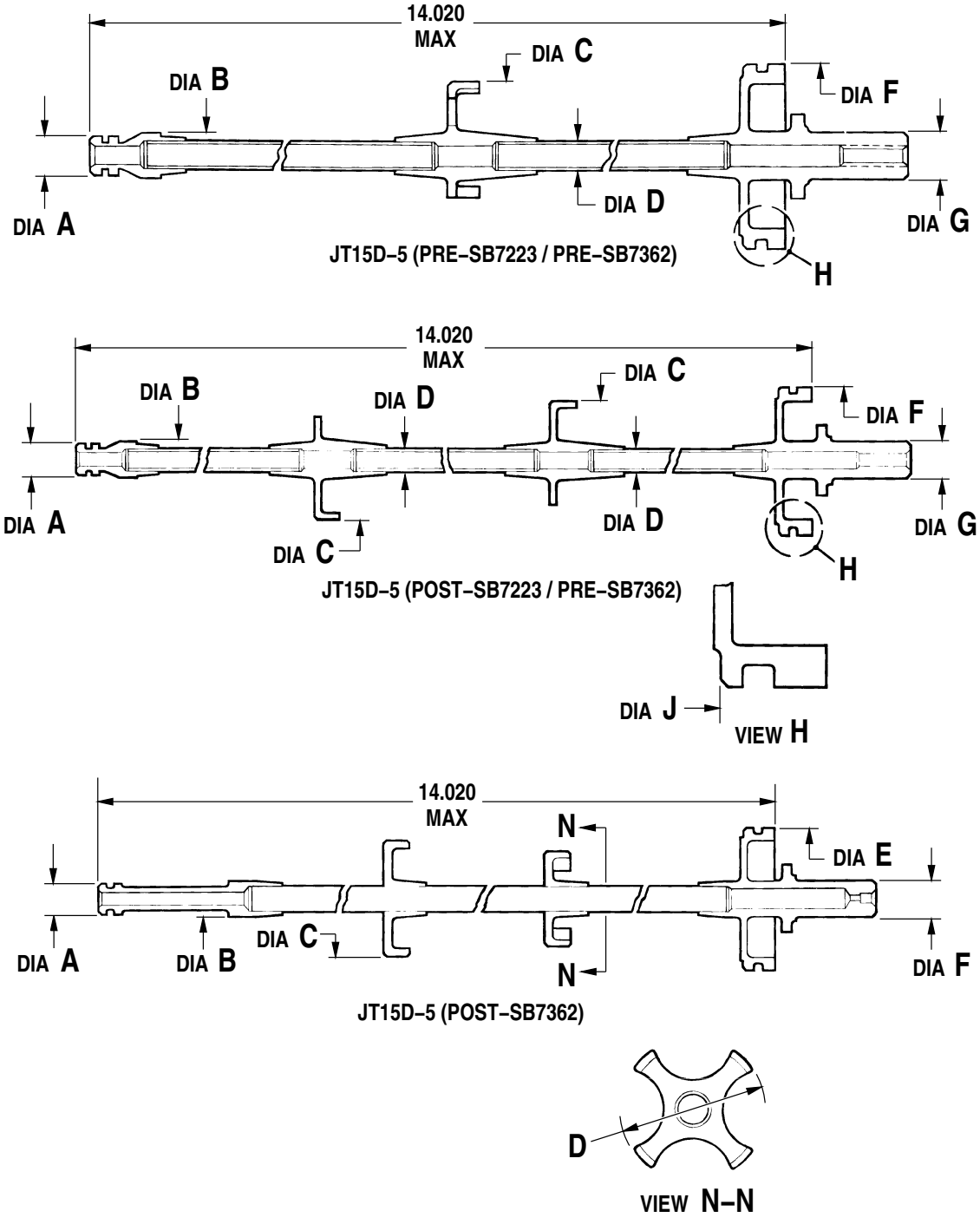

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Intershaft Oil Transfer Tube - Inspection
Figure 203 (Sheet 1 of 2)

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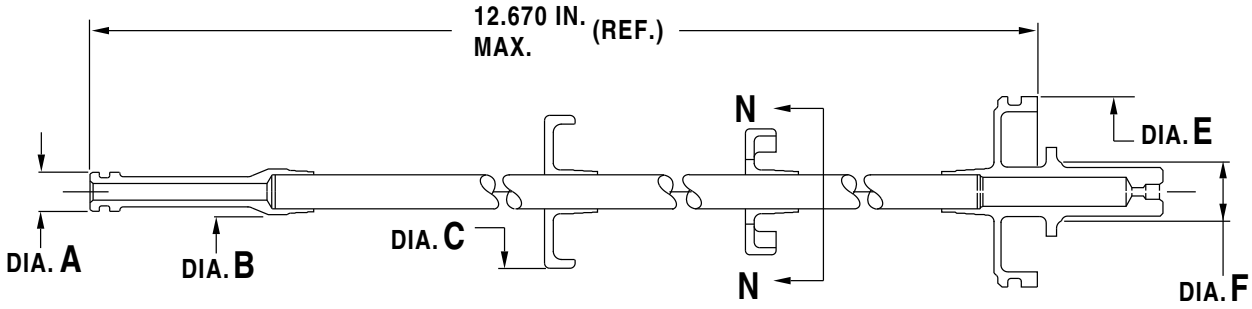
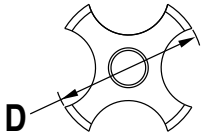


JT15D–5 (POST–SB7452 / POST–SB7530)
AND JT15D–5R



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Intershaft Oil Transfer Tube - Inspection
Figure 203 (Sheet 2)

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7 Circular runout at Dia. J must not exceed 0.003 inch FIR in relation to Dias. A and F.

(b) JT15D-5 (Post-SB7362) engines: with intershaft oil transfer tube supported at Dias. A and E, check tube circular runout as follows:

1 Circular runout at Dia. A must not exceed 0.002 inch FIR in relation to Dia. E.

2 Circular runout at Dias. B, C, D and F must not exceed 0.002 inch FIR in relation to Dias. A and E.

3 Circular runout at Dia. E must not exceed 0.002 inch FIR in relation to Dia. A.

(c) JT15D-5 (Post-SB7452 and Post-SB7530) and JT15D-5R engines: with intershaft oil transfer tube supported at Dias. A and E, check tube circular runout as follows:

1 Circular runout at Dia. A must not exceed 0.002 inch FIR in relation to Dia. E.

2 Circular runout at Dia. B must not exceed 0.005 inch FIR in relation to Dia. E.

3 Circular runout at Dias. C, D and F must not exceed 0.002 inch FIR in relation to Dias. A and E.

4 Circular runout at Dia. E must not exceed 0.002 inch FIR in relation to Dia. A.

7. Cleaning/Painting

A. Intershaft Oil Transfer Tube Assembly

(1) Soak transfer tube in carbon remover compound (PWC11-056) for one to twelve hours at room temperature.

(2) Remove hard or dense carbon deposits with a stiff non-metallic bristle brush.

(3) Pressure-rinse transfer tube thoroughly in hot water.

(4) Inspect bore of tube and general effectiveness of cleaning. Repeat soaking and scrubbing if required.

NOTE: Maximum total soaking time is 24 hours.

(5) Dry transfer tube completely using clean, dry, filtered compressed air.

(6) Seal transfer tube in a clean plastic bag and store until reinstallation.

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B. Low Pressure Turbine Shaft

CAUTION: HANDLE NO.4 BEARING INNER RACE WITH CARE, WEARING CLEAN, LINT-FREE GLOVES.

(1) Remove carbon from bore of low pressure turbine shaft:

(a) Support low pressure turbine rotor balancing assembly on face of turbine disk with shaft vertical and No. 4 bearing up.

(b) Plug No.3 bearing end of LP turbine shaft. Mask and protect exposed No. 4 bearing.

CAUTION: DO NOT ALLOW CARBON REMOVER TO CONTACT ANY PART OF EXPOSED NO.4 BEARING.

(c) Fill shaft with carbon remover (PWC11-056) and soak for one to twelve hours.

(d) Remove hard or dense carbon deposits using rotary non-metallic bristle brush. Use caution to avoid damage to coating.

(e) Remove plug and drain carbon remover (PWC11-056) from shaft bore.

(f) Pressure-rinse shaft thoroughly with hot water. Dry with clean, dry, filtered compressed air.

(g) Inspect bore and forward end of shaft. Ensure bore is clean. Ensure forward end of shaft is absolutely clean and unobstructed.

(h) Repeat soaking and scrubbing if required.

NOTE: Maximum total soaking time is 24 hours.

(i) Cover shaft ends until rotor is installed.

8. Fits, Clearances and Torque Loadings

A. Refer to Table 202, 203, and Figure 204.

TABLE 202, FITS AND CLEARANCES

REF. NO.	Name	Dim. for Ref. (inches)		Limits (inches)		
		Min.	Max.	Min.	Max.	Replace
1088	Disk, High Pressure Turbine Rotor	4.4980	4.5020	0.0320 RADIAL	0.0370	
	Baffle Assembly Turbine Interstage	4.5660	4.5720			

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TABLE 202, FITS AND CLEARANCES (Cont'd)

REF. NO.	Name	Dim. for Ref. (inches) Min.	Dim. for Ref. (inches) Max.	Limits (inches) Min.	Limits (inches) Max.	Limits (inches) Replace
1098	Tube, Intershaft Oil Transfer	1.3780	1.3800	0.0044	0.0228	
	Shaft, Low Turbine	1.3844	1.4008			
1101	Rotor, Low Pressure Turbine			0.0150	0.0250	
	Turbine Stator Assembly, Low Pressure			AVERAGE TIP CLEARANCE		
1108	Support, Intershaft Oil Transfer Tube	1.7240	1.7260	0.0020	0.0050	
	Shaft, Low Pressure Turbine	1.7280	1.7290			
1115	Rotor, Low Pressure Turbine					
	Turbine Stator Assembly, Low Pressure					
	NOTE: 0.015 Minimum Tip Clearance with longest blade and 0.010 Total Clearance Variation with any one blade.					
1337	Tube, Intershaft Oil Transfer	1.3880	1.3900	0.0044	0.0128	
	Shaft, Low Turbine	1.3944	1.4008			

TABLE 203, TORQUE AND STRETCH

REF. NO.	Name	Limits Min.	Limits Max.
1721	Bolt, LP Turbine Shaft Locking: JT15D-5 (Post-SB7315 and Post-SB7452) and JT15D-5R		
	(1) Heat inner surface of LPT shaft at two spigot ends to 400 °F maximum.		

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TABLE 203, TORQUE AND STRETCH (Cont'd)

REF. NO.	Name	Limits Min.	Limits Max.
	(2) Use a hydraulic ram to seat the LP compressor shaft/LPT shaft assy with a load to 8000 - 9000 lbf (2900 to 3250 psi). NOTE: The load-to-psi conversion is derived from the cylinder effective area of the approved hydraulic cylinder (PWC89837). (3) Keep load until parts cool to room temperature. (4) Install LPT shaft locking bolt and torque to 350 - 400 lb.in. (5) Do not lubricate threads. (6) Do not lubricate cupwasher: it must be clean and dry.		

TABLE 204, SPRING PRESSURE

REF. NO.	Name	Limits Min.	Limits Max.
	Not Applicable		

TABLE 205, SPECIAL ASSEMBLY

REF. NO.	Name	Limits Min.	Limits Max.
	Not Applicable		

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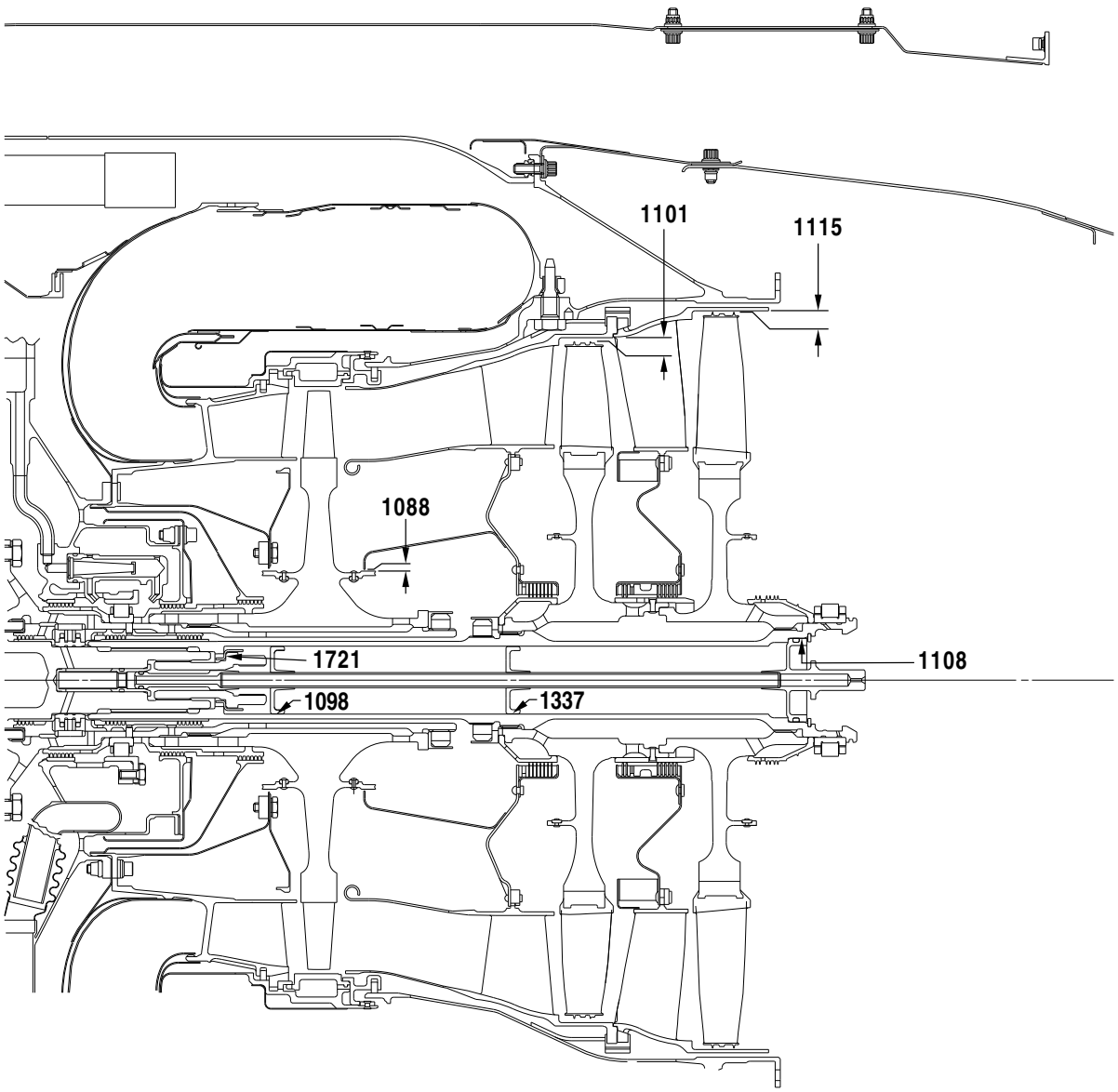

C32780B

Fits, Clearances and Torque Loadings
Figure 204

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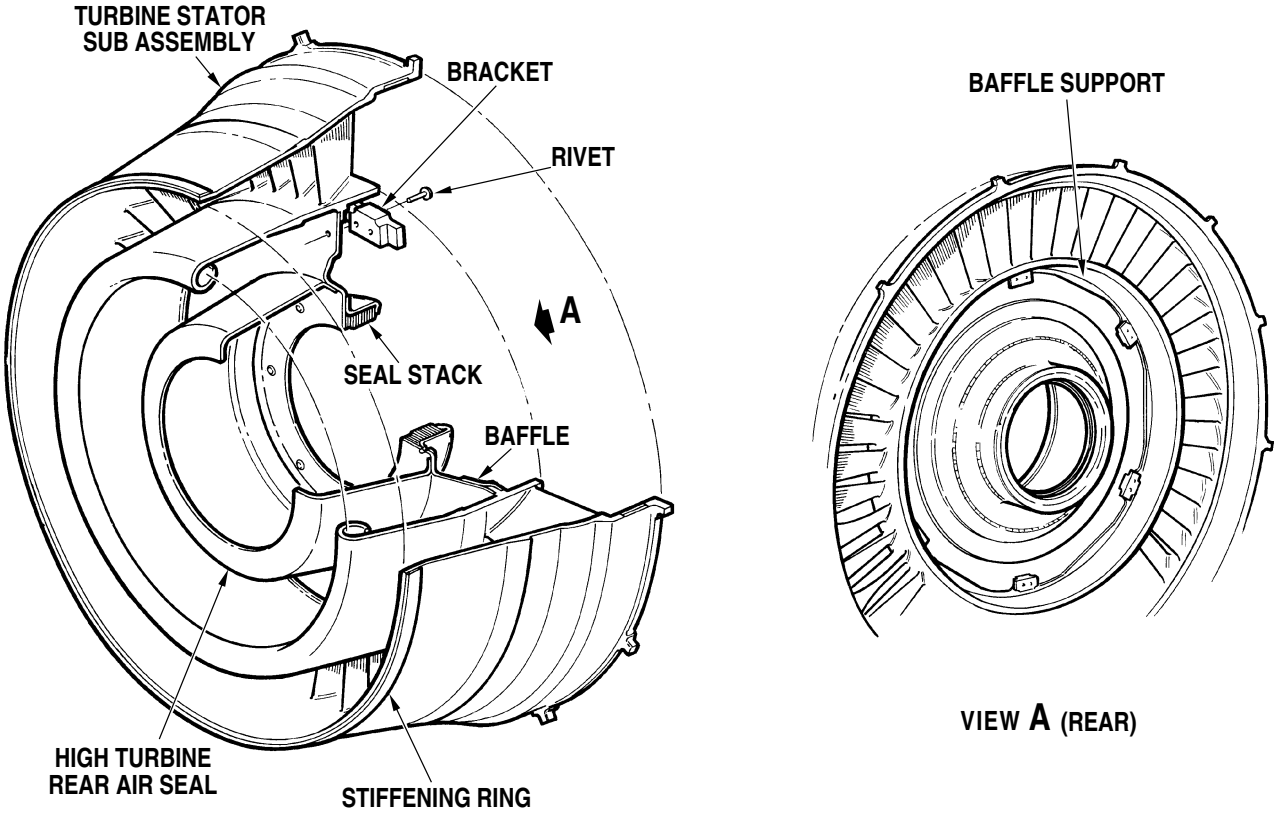
SECOND-STAGE LPT STATOR - DESCRIPTION AND OPERATION

1. Description (Ref. Fig. 1)

The LP turbine stator assembly consists of two basic concentric parts: an outer cobalt alloy cast stator assembly and an inner baffle assembly. The stator assembly is housed in and secured by the LP turbine stator support assembly. It consists of an annular passage formed by two concentric sheet metal duct extensions welded to the inner and outer platforms which incorporate 47 vanes. The front of the outer extension fits into the high pressure turbine shroud housing, while the rear extension of the outer platform forms the first LP turbine shroud.

The interstage baffle assembly is supported by the inner circumference of the stator assembly. It consists of the baffle which mounts the high pressure turbine rear air seal at the front and the stator air seal stack assembly at the rear.



C11311A

Second-Stage Low Pressure Turbine Stator Assembly (Typical)
Figure 1

SECOND-STAGE LPT STATOR - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the second-stage LPT stator.

2. Consumable Materials

   Not Applicable

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation (Heavy Maintenance Only)

   Removal/Installation of the LP turbine stator assembly is a simple operation accomplished in conjunction with removal/installation of the low pressure turbine rotor balance assembly. Refer to 72-50-03, MAINTENANCE PRACTICES, Removal/Installation for the combined procedure.

6. Inspection/Check

   A. Procedure

      (1) Inspect LP turbine stator assembly, refer to Figure 201 and Table 201.

      (2) Visually inspect baffle and air seal for condition.

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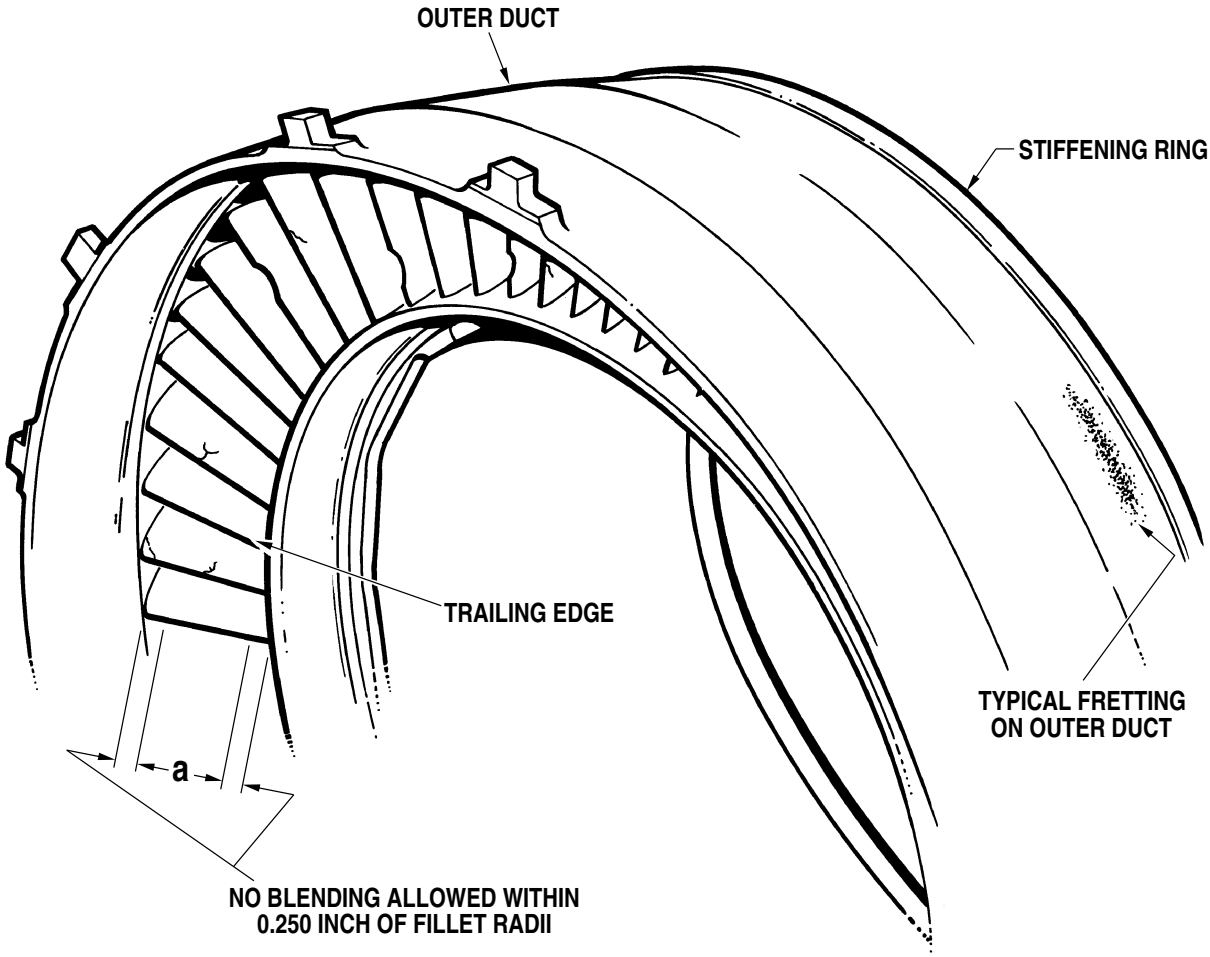

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LP Turbine Stator Assembly - Inspection
Figure 201

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TABLE 201, LP Turbine Stator Assembly Inspection

INSPECTION	MAXIMUM SERVICEABLE	MAXIMUM REPAIRABLE	CORRECTIVE ACTION
Erosion or Chipping			
Vanes			
Leading edges	Up to 0.060 inch smooth bottomed	Blend as necessary to obtain maximum serviceability.	Replace
Trailing edges	Up to 0.060 inch smooth bottomed on any number of vanes.	Up to 0.300 inch depth on a maximum of five vanes and only one blending area per vane permitted. Confine repair to area 'a' (201) and blend out. Minimum radius 0.125 inch.	Replace if beyond repairable limits.
Cracking			
Vanes			
Trailing Edges	Any number of hairline cracks not exceeding 0.300 inch in length	Open cracks not exceeding 0.300 inch in length on up to five vanes and only one blending area per vane permitted. Confine repair to Area 'a' (Fig. 201) and blend out. Minimum radius 0.125 inch.	Replace if beyond repairable limits.
Outer Vane Ring	Up to 0.600 inch	Not repairable	Return to approved overhaul facility
Stiffening Ring			
Pre-SB7426 stators: dye penetrant inspect or fluorescent penetrant inspect (Ref. SB7426) with attention to axial and circum-ferential welds (Ref. Fig. 202).	No cracks permitted	See corrective action	Replace with Post-SB7426 stator. Return stator to approved overhaul facility for rework in accordance with SB7426.
Inner Vane Ring	Up to 0.400 inch	Not repairable	Return to approved overhaul facility.

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TABLE 201, LP Turbine Stator Assembly Inspection (Cont'd)

INSPECTION	MAXIMUM SERVICEABLE	MAXIMUM REPAIRABLE	CORRECTIVE ACTION
Sheet Metal Ducts **	Cracks are not acceptable upstream of vane ring	Not repairable	Return to approved overhaul facility.
Fretting			
Outer Sheet Metal Duct **	Local fretting acceptable provided that wear is less than 50 percent of original thickness	Not repairable	Replace
Stiffening Ring **	Fretting acceptable if remaining thickness of ring is at least 0.050 inch	Not repairable	Replace

If replacement of the low pressure stator assembly is necessary, a stator having a similar throat area + 0.4 to 0 square inch must be installed.

** Assemblies showing damage in excess of specified limits may be repaired at an approved overhaul facility.

7. Fits, Clearances and Torque Loadings

For Fits, Clearances and Torque Loadings, refer to Chapter 72-50-03.

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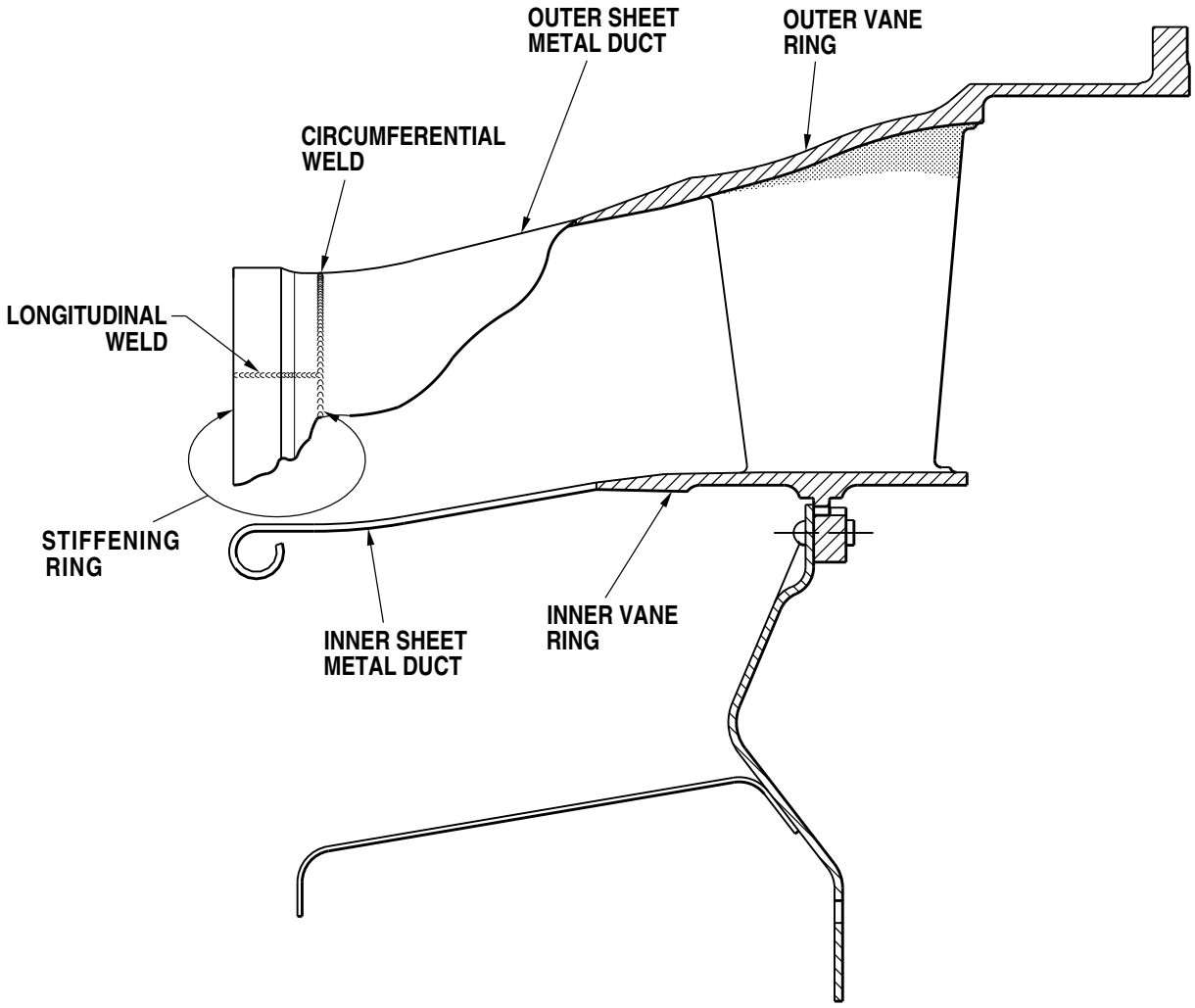

PRE-SB7426

C34004A

Second Stage LPT Stator Outer Ring - Inspection
Figure 202

THIRD-STAGE LP TURBINE STATOR- DESCRIPTION AND OPERATION

1. General

The third-stage LP turbine stator assembly is located between the second and third-stage LP turbine disks and forms part of the low pressure turbine rotor balancing assembly. The stator assembly is fully described in Chapter 72-50-03.

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EXHAUST DUCT, NO. 4 BEARING HOUSING - DESCRIPTION AND OPERATION

1. Exhaust Duct (Ref. Fig. 1)

The turbine exhaust duct assembly consists of a front and a rear duct. The front flange of the nickel alloy front exhaust duct assembly is bolted to the LP turbine stator support assembly at flange D. A heat shield installed between the second stage LP turbine stator assembly and the forward lip of the exhaust duct front flange serves to protect the flange from excessive heat. The rear exhaust duct assembly incorporates a welded bracket located at top center and provides for attachment of the engine lifting sling. The rear exhaust duct flange is secured to the front exhaust duct rear flange with 21 bolts and shank nuts.

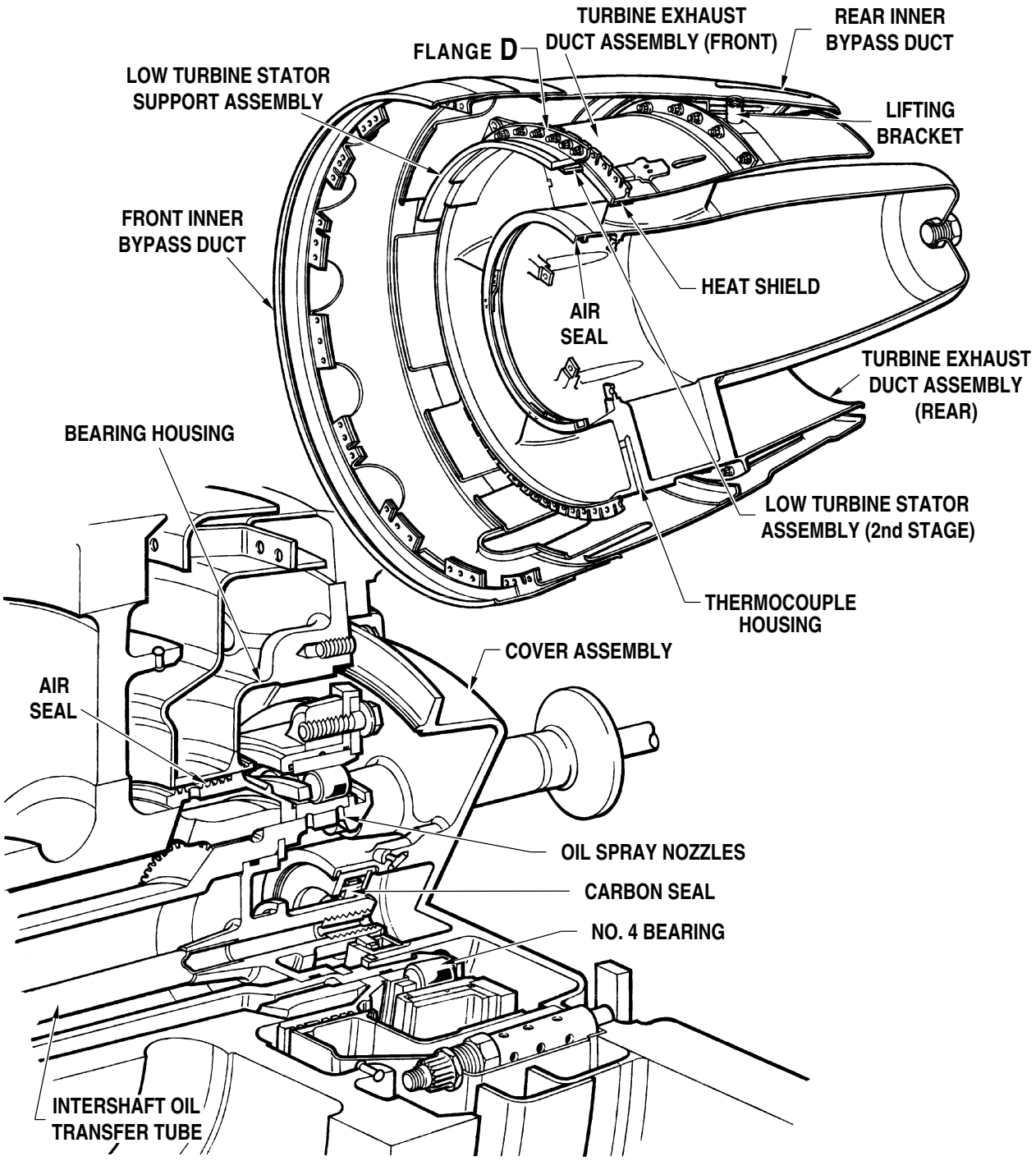
The duct assembly consists of inner and outer exhaust ducts supported by six equally spaced hollow struts. The struts in the 5 and 7 o'clock positions, respectively, provide passage for the No. 4 bearing pressure and scavenge oil lines. A radial bore, with an air slot in the leading edge of each strut, houses one of the six T6 thermocouples. Six lugs on the inner exhaust duct support the No. 4 bearing housing with its cover. A flexible air seal is located on the inner diameter of the front exhaust duct. The airframe-supplied hot and cold mixing nozzles, are standard non-classified; datum N1 speed being set at the EEC trim plug.

The No. 4 bearing is sealed in a housing and cover assembly. The forward bore structure of the bearing housing forms the stationary runner of the No. 4 bearing air seal. The cover assembly incorporates the lubricating oil inlet and oil jet strainer. An integral gallery in the cover assembly discharges oil through a central port directly into the intershaft oil transfer tube for lubrication of the No. 3-½ bearing. An extension of the integral gallery discharges oil through front and rear spray nozzles to the No. 4 bearing. A carbon seal in the cover assembly prevents oil leakage between the intershaft oil transfer tube and the cover. The overspeed control actuating rod protrudes through the cover assembly and is linked to a control lever mounted on its outer surface.

A system of controls is installed to shut off the fuel supply in order to prevent possible overspeed of the LP turbine assembly. This chapter details maintenance procedures for emergency fuel shutoff control linkage components on and contained within the No.4 bearing housing and the exhaust duct. Refer to Chapter 73-10-11 for procedures to reset the shutoff valve and to install the connecting linkage.

A system of controls is installed to shut off the fuel supply in order to prevent possible overspeed of the LP turbine assembly. The overspeed control actuating rod protrudes through the cover assembly and is linked to a control lever mounted on the cover's outer surface. A cable connects the first lever to a bellcrank lever secured to a bracket on the outside of the exhaust duct. An adjustable turnbuckle assembly connects the bellcrank lever to a third lever and the emergency fuel control shutoff valve at the fuel manifold inlet adapter (Ref. 73-10-11) .

This chapter details maintenance procedures for emergency fuel shutoff control linkage components on and contained within the No.4 bearing housing and the exhaust duct. Refer to Chapter 73-10-11 for procedures to reset the shutoff valve and to install the connecting linkage.



C11474B

Turbine Exhaust Duct and No. 4 Bearing Housing Assembly
Figure 1

ENGINE CONTROLS - FAULT ISOLATION

1. Fault Isolation

   For detailed fault isolation procedures for engine controls, refer to Chapter 72-00-00, FAULT ISOLATION, Fault Isolation for Engine Start Faults and Fault Isolation for Engine Operating Problems.

EXHAUST DUCT ASSEMBLY - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the exhaust duct and No. 4 bearing housing assemblies.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Engine Lubricating Oil
PWC05-068	Masking Tape
PWC05-151	Filler Wire, Welding
PWC09-005	Joining Compound
PWC11-012	Acetone
PWC11-014B	Isopropyl Alcohol (Commercial Grade)
PWC11-027	Petroleum Solvent
PWC11-056	Alkaline Carbon Remover

3. Special Tools

   The special tools listed below are used in the following procedures.

Tool No.	Name
PWC30128-06	Puller
PWC30304-09	Set (Post-SB7306)
PWC30304-18	Set (Post-SB7306)
PWC31274	Puller
PWC31563	Drift
PWC31572	Base
PWC31642	Holder, T-headed bolts
PWC31661	Gage, Overspeed Control Setting
PWC31687	Riveter (Post-SB7306)
PWC52111	Drift, No. 4 Bearing Housing Sleeve
PWC52112	Drift, No. 4 Bearing Housing Sleeve
PWC60769	Seal Assembly Tool

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation (Heavy Maintenance Only)

   A. Removal of Turbine Exhaust Duct (Ref. Fig. 201)

      (1) Remove rear inner bypass duct (Ref. 72-70-02).

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(2) Disconnect T6 thermocouple wiring harness from T1 thermocouple wiring harness and remove T6 harness (Ref. 77-00-02).

(3) Disconnect oil pressure and scavenge oil tubes (1) at rear of bypass duct at the 5 and 7 o'clock positions by removing two self-locking nuts (2), washers (3), brackets (12) and bolts (4). Discard two preformed packings (5).

(4) Remove two self-locking nuts (6) and washers (7) securing pressure and scavenge oil elbows (8) to bypass duct bosses. Remove elbows.

(5) Remove oil pressure and scavenge oil transfer tubes (9) through bypass duct bosses using puller (PWC30128-06). Discard preformed packings (10) and (11).

(6) Disconnect shutoff valve linkage (13) (Ref. 73-10-11).

CAUTION: DO NOT REMOVE BOLTS SECURING REAR ENGINE MOUNT BRACKETS AT FLANGE POSITIONS D AND F (Ref. Fig. 201).

(7) Remove remaining nuts, spacers, bolts, washers and cotterpins securing turbine exhaust duct (14) to LP turbine stator support assembly (15).

NOTE: Bolts, spacers and self-locking nuts at locations D and G are removed with T6 thermocouple wiring harness.

CAUTION: EXERCISE CARE WHEN REMOVING THE EXHAUST DUCT ASSEMBLY, TO AVOID DAMAGING THE CARBON SEAL IN NO. 4 BEARING HOUSING COVER ASSEMBLY.

(8) Remove turbine exhaust duct (14), together with No. 4 bearing housing assembly, from LP turbine stator support assembly (15).

(9) Remove heat shield (16) from exhaust duct.

(10) Cover rear of LP turbine shaft with plastic bag to protect No. 4 bearing inner race and rollers.

(11) JT15D-5 (Pre-SB7425) engines: if required, remove 21 bolts (27), then separate front and rear exhaust duct assemblies.

B. Installation of Turbine Exhaust Duct (Ref. Fig. 201)

CAUTION: DO NOT DRAW EXHAUST DUCT FLANGE INTO POSITION BY TORQUING BOLTS, OR USE FORCE TO OBTAIN FACE-TO-FACE CONTACT BETWEEN EXHAUST DUCT FLANGE AND LP TURBINE STATOR SUPPORT FLANGE. IF NORMAL FACE-TO-FACE CONTACT BETWEEN FLANGES CANNOT BE OBTAINED, DISASSEMBLE AND DETERMINE CAUSE.

NOTE: Rigid adherence to preceding caution will ensure correct seating of second-stage LP turbine stator assembly.

(1) JT15D-5 (Pre-SB7425) engines: if exhaust duct assembly was separated, reassemble front and rear ducts. Secure rear exhaust duct (26) to front exhaust duct (25) with 21 bolts (27). Tighten bolts and torque to 32 to 36 lb.in.

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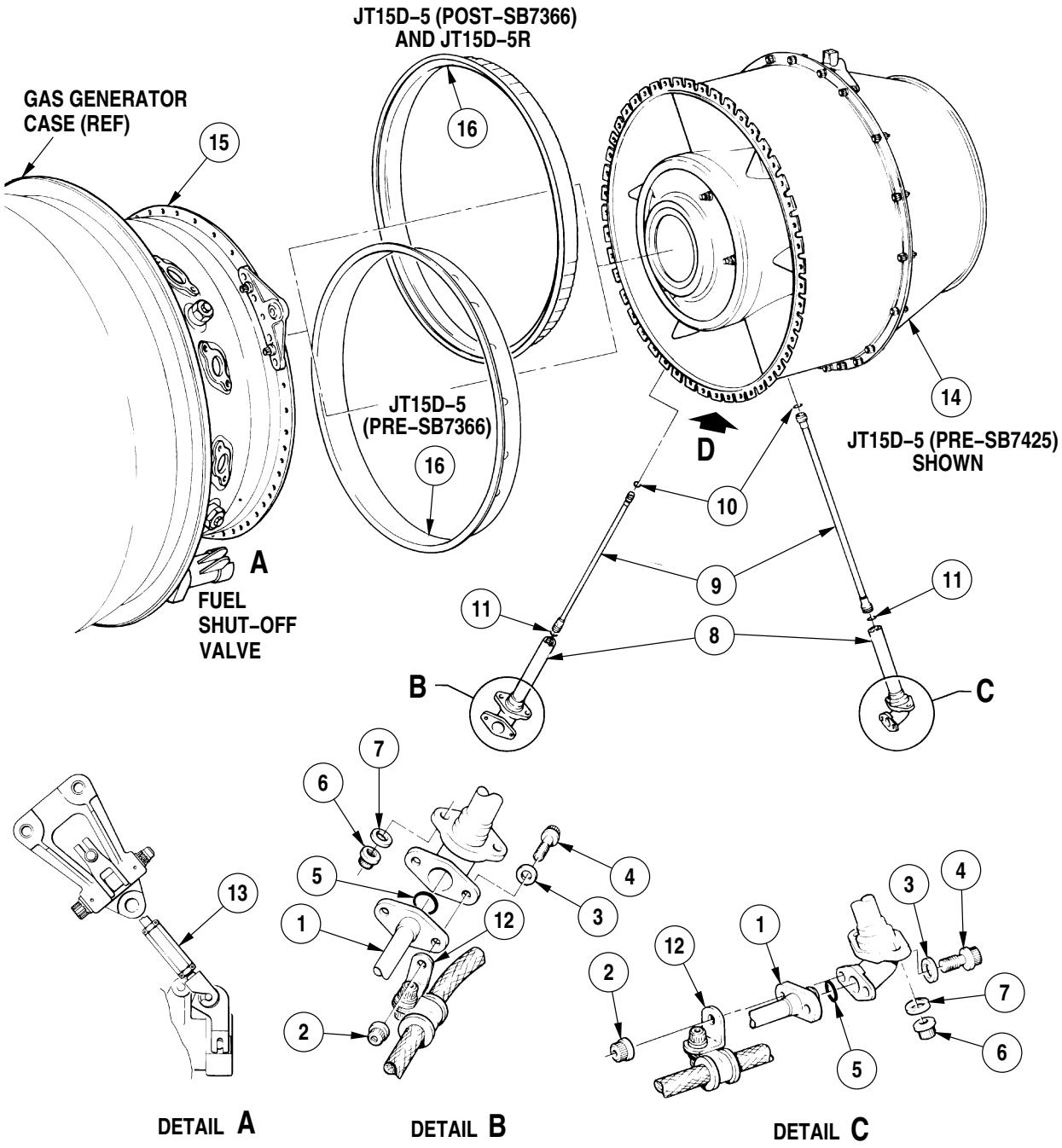

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Removal/Installation - Turbine Exhaust Duct and No. 4 Bearing Housing Assembly
Figure 201 (Sheet 1 of 3)

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Key to Figure 201

1. Oil Tube
2. Self-locking Nut
3. Washer
4. Bolt
5. Preformed Packing
6. Self-locking Nut
7. Washer
8. Elbow
9. Oil Transfer Tube
10. Preformed Packing
11. Preformed Packing
12. Bracket
13. Bellcrank-to-Shutoff Valve Linkage
14. Turbine Exhaust Duct
15. LP Turbine Stator Support
16. Heat Shield
17. Bolt
18. Washer
19. Castellated Nut
20. Cotterpin
21. Bolt
22. Self-locking Nut
23. Bolt
24. Self-locking Nut
25. Exhaust Duct Assembly (Front)
26. Rear Turbine Exhaust Duct Assembly
27. Bolt
28. Washer
29. Bolt

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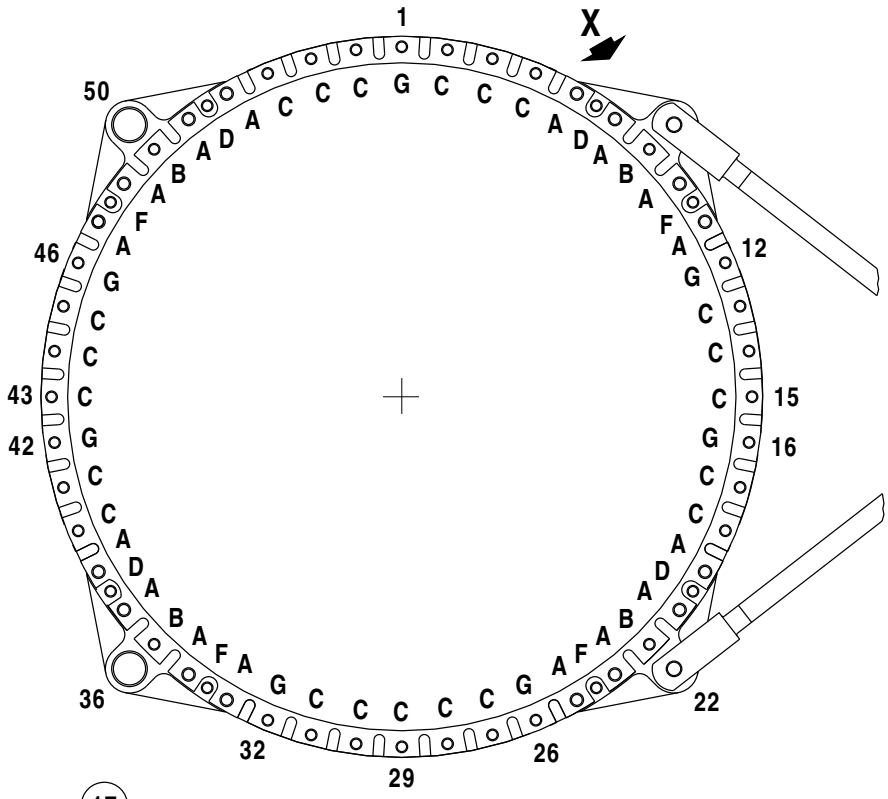
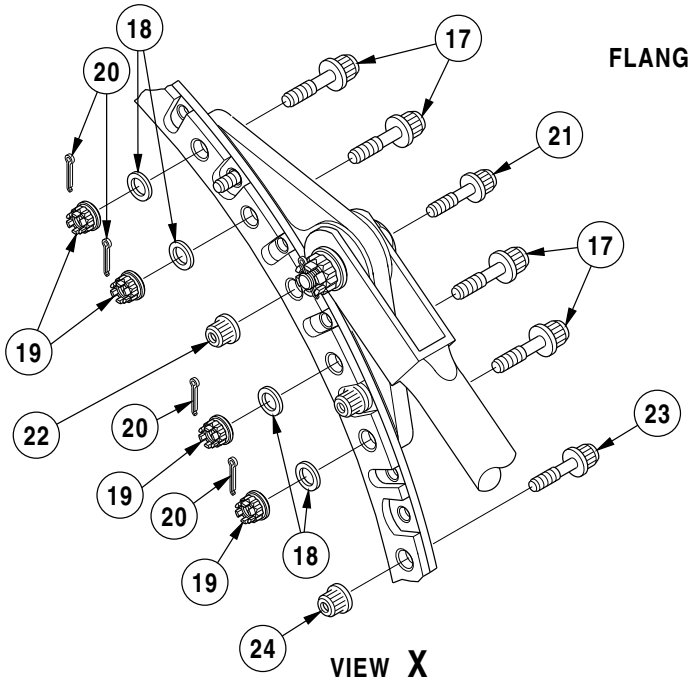


FLANGE **D** (VIEW FROM REAR)



VIEW **X**

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Removal/Installation - Turbine Exhaust Duct and No. 4 Bearing Housing Assembly
Figure 201 (Sheet 2)

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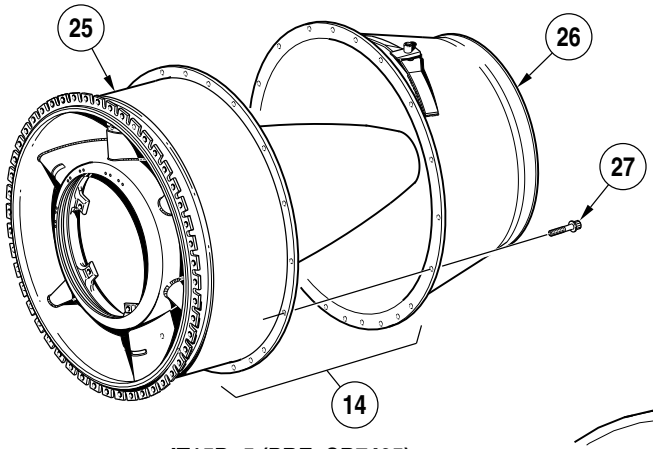
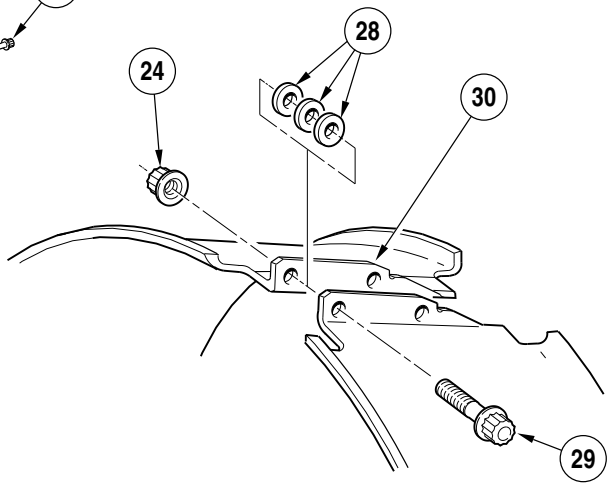
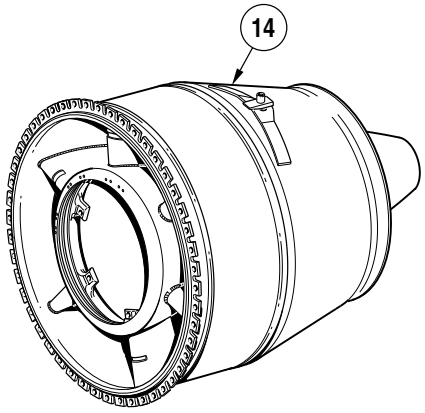


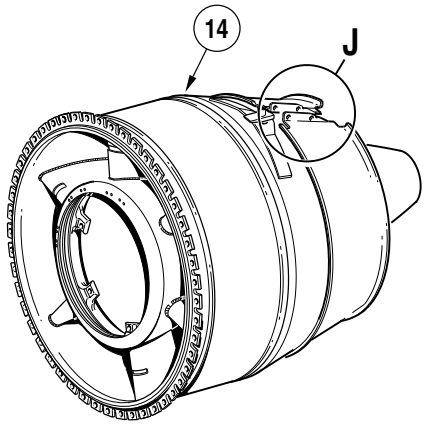
JT15D–5 (PRE–SB7425)



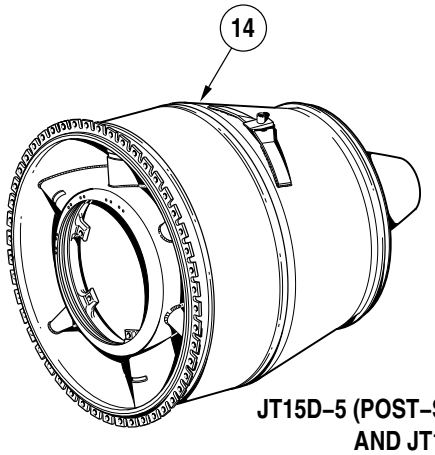
DETAIL J



JT15D–5 (POST–SB7425)



JT15D–5 (POST–SB7472)



JT15D–5 (POST–SB7471 / SB7501)
AND JT15D–5R

C39300A

Removal/Installation - Turbine Exhaust Duct and No. 4 Bearing Housing Assembly
Figure 201 (Sheet 3)

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CAUTION: EXERCISE CARE WHEN POSITIONING EXHAUST DUCT ASSEMBLY TO AVOID DAMAGING THE CARBON SEAL IN NO. 4 BEARING HOUSING COVER ASSEMBLY.

(2) Ensure heat shield (16) is correctly positioned in turbine exhaust duct (14). Position exhaust duct on LP turbine stator support assembly (15). Obtain face-to-face contact, without use of force, between rear flange of low pressure turbine stator support and front flange of exhaust duct. Secure with 16 bolts (17), washers (18) and castellated nuts (19) at positions A. Tighten nuts, torque 65 to 85 lb.in. and secure with cotterpins (20).

(3) Install four bolts (21) and self-locking nuts (22) at positions B. Tighten nuts and torque 36 to 40 lb.in.

(4) Install 21 bolts (23) and self-locking nuts (24) at positions C. Tighten nuts and torque 36 to 40 lb.in.

NOTE: Flange D hardware at locations D and G is installed with T6 thermocouple wiring harness.

(5) JT15D-5 (Post-SB7472) engines: if stiffening band (30) was removed, install as follows:

(a) Secure band (30) on rear of exhaust duct with two bolts (29), the predetermined quantity of washers (28) placed between the band clamps, and two self-locking nuts (24). Tighten and torque nuts to 40 lb.in.

NOTE: The existing quantity of washers, up to a maximum of six per bolt, was determined at initial installation. Refer to latest revision of Service Bulletin.

(6) Install T6 thermocouple wiring harness (Ref. 77-00-02).

(7) Connect fuel shutoff valve linkage (Ref. 73-10-11).

CAUTION: ENSURE THAT PORTS IN EXHAUST DUCT, THROUGH WHICH OIL TRANSFER TUBES PASS, ARE CLEAN AND FREE FROM DIRT AND/OR DEPOSITS.

CAUTION: INSERT TRANSFER TUBES WITH ONE INWARD MOVEMENT UNTIL FULLY SEATED. ANY OUTWARD MOVEMENT OF TUBE AFTER PACKING HAS PASSED THROUGH EXHAUST DUCT VANE WILL CAUSE PACKING DAMAGE.

(8) Refer to Figure 201. Install preformed packings (10) and (11) respectively on inboard and outboard ends of oil pressure and scavenge transfer tubes (9). Insert transfer tubes through bypass duct bosses located at the 5 and 7 o'clock positions.

(9) Install oil pressure and scavenge elbows (8) on bosses and secure with two washers (7) and self-locking nuts (6). Tighten nuts and torque 32 to 36 lb.in.

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(10) Install preformed packings (5) and reconnect oil pressure and scavenge tubes (1) to elbows with two bolts (4), washers (3), brackets (12) and self-locking nuts (2).

(11) Tighten nuts and torque 32 to 36 lb.in.

(12) Install rear inner bypass duct (Ref. 72-70-02).

(13) Reconnect T6 thermocouple wiring harness to T1 thermocouple wiring harness (Ref. 77-00-02).

(14) Install rear inner bypass duct (Ref. 72-70-02).

(15) Reconnect T6 thermocouple wiring harness to T1 thermocouple wiring harness (Ref. 77-00-02).

C. Removal of No. 4 Bearing Housing and Cover Assembly (Ref. Fig. 202)

(1) Disengage ball end of cable assembly from bellcrank externally mounted on exhaust duct .

(2) Remove No. 4 bearing housing as follows:

(a) Remove six self-locking nuts (2), heatshield (3) and spacers (4) from housing assembly.

(b) Remove six threaded sleeve spacers (5) and No. 4 bearing housing assembly from exhaust duct.

(c) Remove six T-headed bolts (18) and bearing housing assembly.

(3) For disassembly of the No. 4 bearing housing, refer to Subpara. G.

D. Installation of No. 4 Bearing Housing and Cover Assembly (Ref. Fig. 202)

(1) With cable assembly (13, Fig. 204) through strut at seven o'clock position of exhaust duct, position bearing housing assembly with cover assembly on exhaust duct mounting lugs, ensuring that mating faces are in full, even contact.

(2) Using holder (PWC31642), install six T-headed bolts ((18), Fig. 202) from rear of exhaust duct (17) lugs and retain with six threaded sleeve spacers (5). Handtighten sleeve spacers and torque 42 to 44 lb.in. using a star pattern (Ref. Fig. 203).

(3) Temporarily install heat shield ((3), Fig. 202) over T-headed bolts (18) and sleeve spacers (5). Check for correct bolt alignment with six holes in heat shield. Remove heat shield.

(4) Using a suitable soft drift and eight-ounce hammer, tap No. 4 bearing housing lugs lightly in a circular pattern to ensure full seating of T-headed bolt and sleeve spacers. Check spacer torque and torque again to 42 to 44 lb.in., if required.

(5) One at a time, loosen spacer torque to zero; then, using star pattern (Ref. Fig. 203), apply final torque to sleeve spacers (REF. NO. 1749, Table 202). Tap bearing housing lugs as in step (4) and check torque again.

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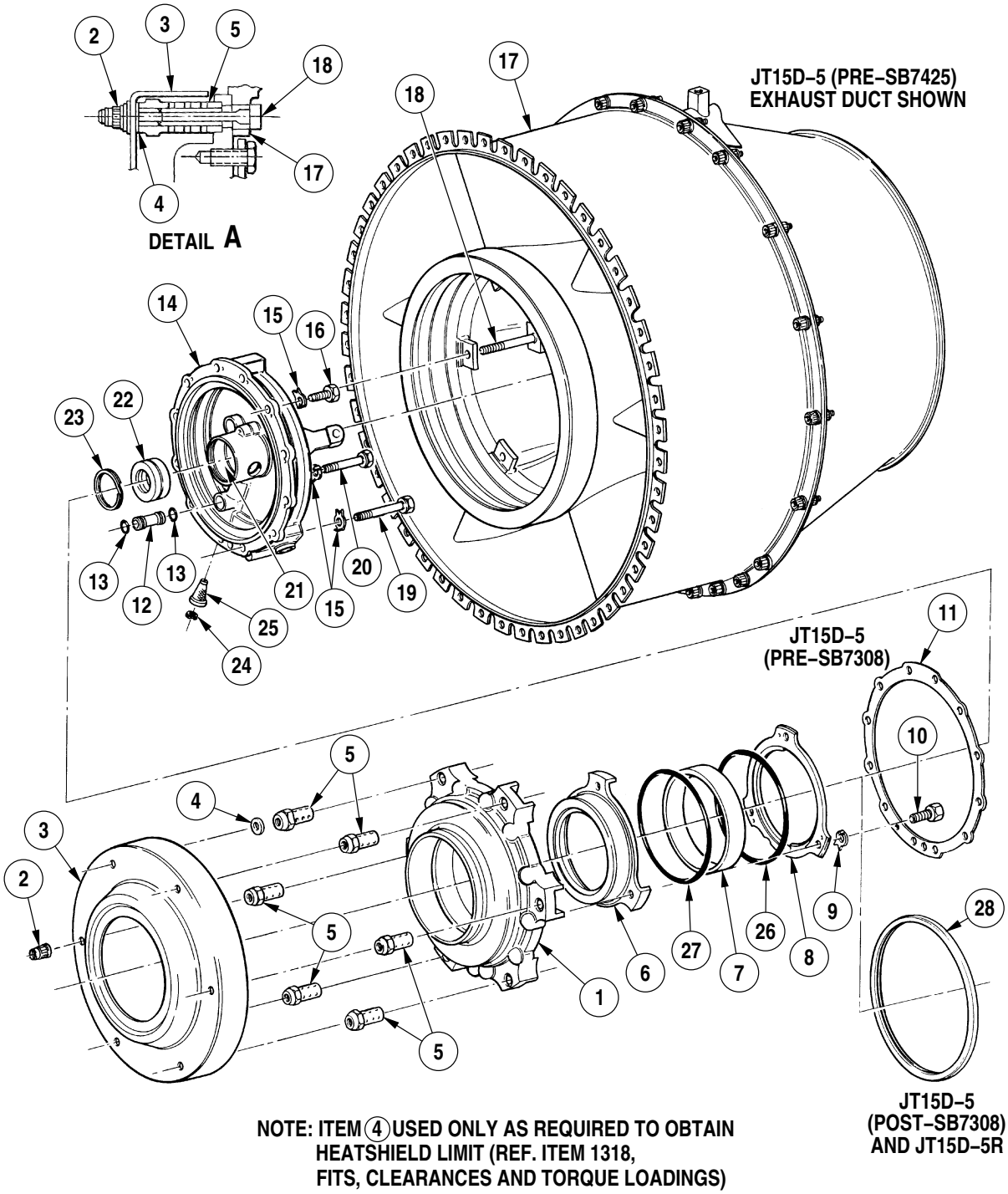

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Removal/Installation - No. 4 Bearing Housing and Associated Parts
Figure 202 (Sheet 1 of 2)

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Key to Figure 202

1. No. 4 Bearing Housing
2. Self-locking Nut
3. No. 4 Bearing Heat Shield
4. Adjustment Washer
5. Sleeve Spacer
6. No. 4 Bearing Sleeve
7. No. 4 Bearing Outer Race
8. Retaining Ring
9. Keywasher
10. Bolt
11. Gasket (Pre-SB7308)
12. Transfer Tube
13. Preformed Packing
14. No. 4 Bearing Housing Cover
15. Keywasher
16. Bolt
17. Turbine Exhaust Duct
18. T-headed Bolt
19. Bolt
20. Bolt
21. Carbon Seal Housing (Integral Part of Item 14)
22. Carbon Seal
23. Retaining Ring
24. Retaining Ring
25. Strainer
26. Preformed Packing
27. Preformed Packing
28. Seal (Post-SB7308)

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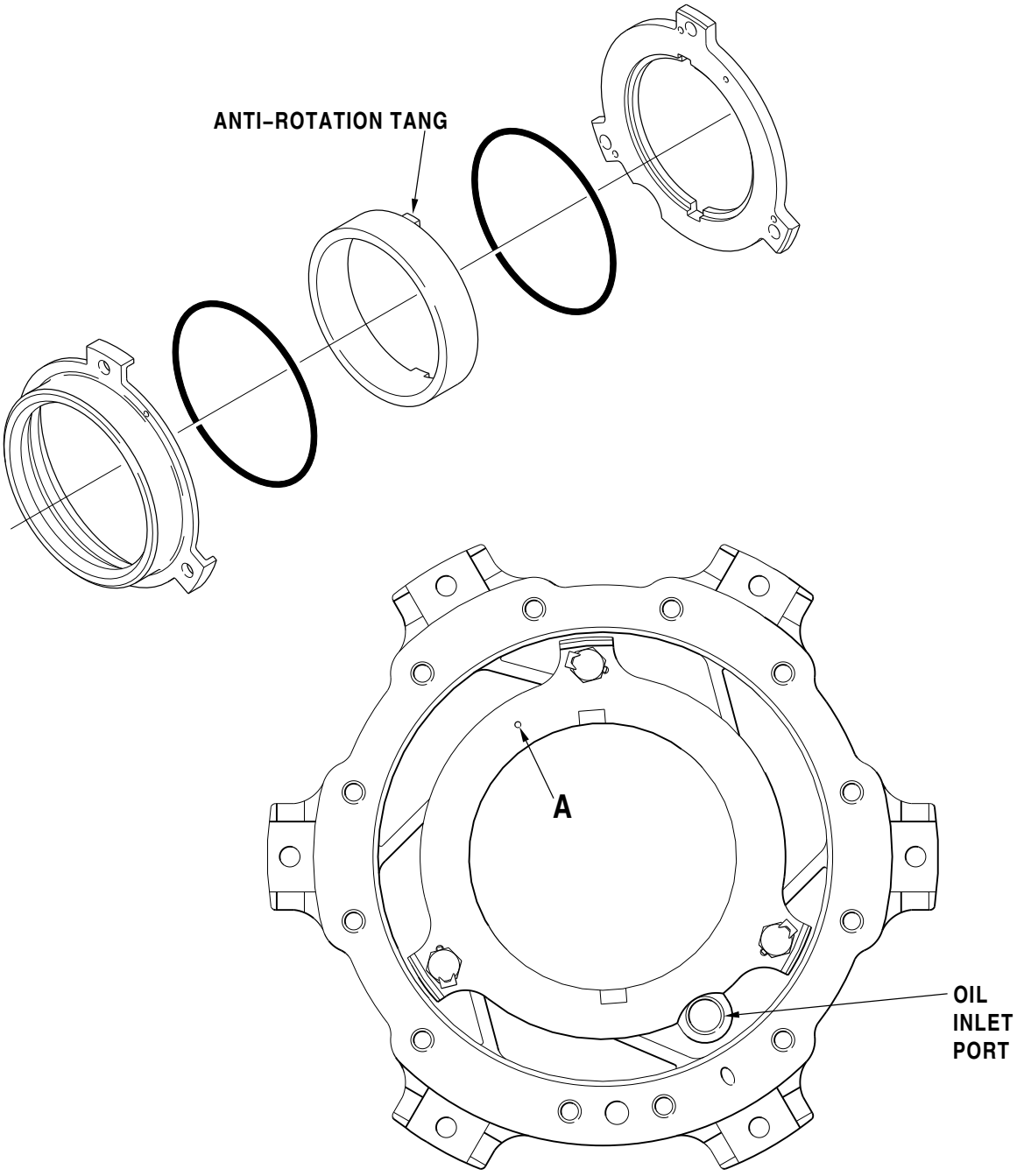

C32058

Removal/Installation - No. 4 Bearing Housing and Associated Parts
Figure 202 (Sheet 2)

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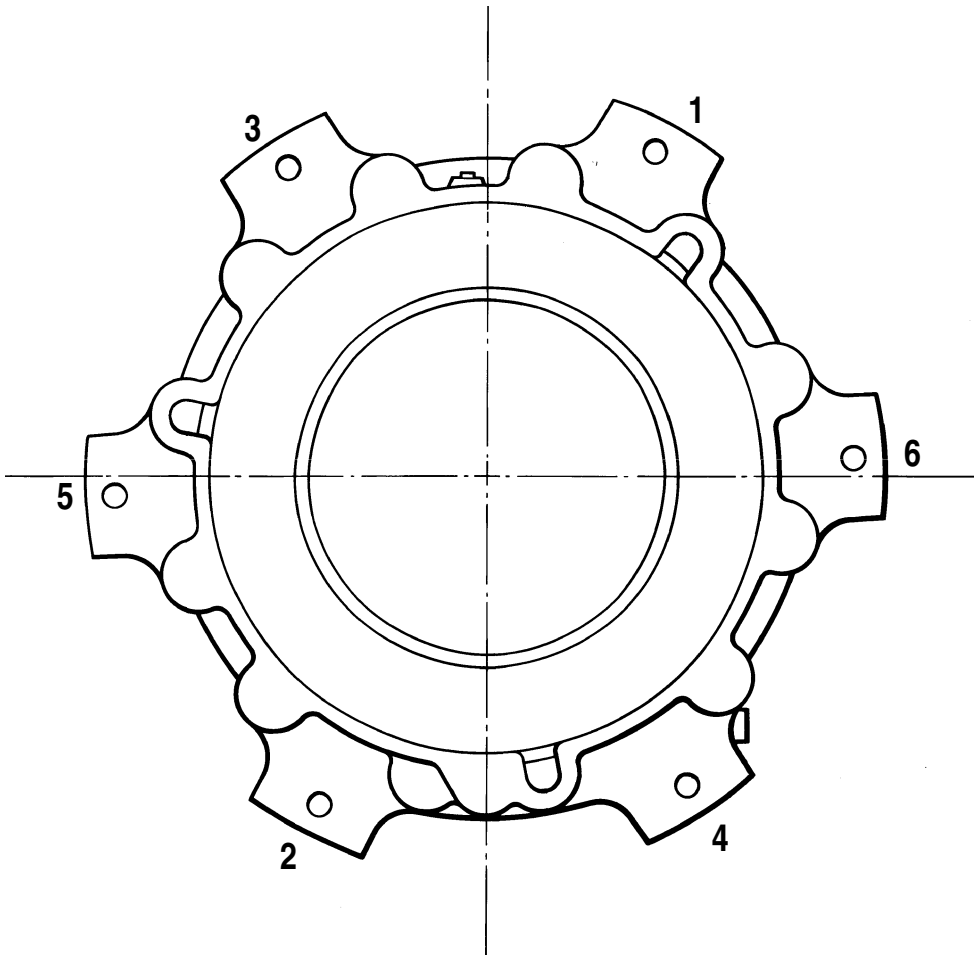

C11393

No. 4 Bearing Cover and Heatshield Torque Sequence
Figure 203

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(6) Temporarily install heat shield (3, Fig. 202), using sufficient adjustment washers (4) between heat shield and sleeve spacers (5) to ensure that a clearance gap is obtained between shield and front face of No. 4 bearing stator air seal. Secure shield with three self-locking nuts (2).

(7) Using feeler gage, check obtained clearance of various points and record average clearance.

(8) Remove self-locking nuts (2) and heat shield. Remove sufficient quantity of adjustment washers (4) to obtain an interference fit (REF. NO. 1318, Table 201). Final number of adjustment washers that remain installed must not exceed one (1) per T-headed bolt.

NOTE: Washer thickness is 0.028 to 0.036 inch.

(9) Reinstall heat shield (3), install six self-locking nuts (2) and torque (REF. NO. 1734, Table 202).

(10) JT15D-5 (Pre-SB7281/Pre-SB7306) engines (Fig. 204):

(a) Engage ball end of cable assembly (13) with socket of bellcrank externally mounted on exhaust duct.

(b) Position bellcrank (12) between fork on overspeed control bracket (10). Align holes in bellcrank and bracket. Install headless pin (11) and secure with two cotterpins (14).

(11) JT15D-5 (Post-SB7281/Pre-SB7306) engines (Fig. 204):

(a) Engage ball end of cable assembly (13) with socket of bellcrank (12).

(b) Position bellcrank (12) between fork on overspeed control bracket (10). Align holes in bellcrank and bracket. Install D-headed bolt (23) and castellated nut (22).

(c) Tighten castellated nut (22) until there is a clearance of 0.003 inch at dimension Z between bellcrank (12) and bracket (10). Secure with cotterpin (21).

(d) Using a punch, stake bolt (23) thread between nut (22) castellations in two opposite positions, ensuring that a minimum of one thread is flattened flush with bolt shank.

(12) JT15D-5 (Post-SB7306) engines (Fig. 204):

(a) Engage ball end of cable assembly (13) with socket of bellcrank (12). Position bracket assembly on exhaust duct (28) mounting boss and secure with three bolts (17). Torque bolts 24 to 36 lb.in. and lockwire.

(13) JT15D-5 (Post-SB7384) and JT15D-5R engines (Fig. 204):

(a) Engage ball end of cable assembly (13) with socket of bellcrank externally mounted on exhaust duct.

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(14) Install exhaust duct (Ref. Subpara. B.).

E. Removal of Emergency Fuel Shutoff Valve Control Linkage (Ref. Fig. 204)

NOTE: It is assumed the No. 4 bearing housing assembly has been removed (Ref. Subpara. C.).

(1) JT15D-5 (Pre-SB7306) engines:

(a) Pre-SB7281 engines: remove two cotterpins (9) securing headless pin (8) and remove pin.

(b) Post-SB7281 engines: remove cotterpin (19) , castellated nut (18) and D-headed bolt (20).

(c) Remove lever (5) from bracket on rear face of No. 4 bearing housing cover (1).

(2) JT15D-5 (Post-SB7306) engines:

CAUTION: DO NOT DAMAGE PARENT MATERIAL WHEN REMOVING RIVET.

(a) Support mounting lugs on No. 4 bearing housing cover (1) and remove upset head of rivet (33) by grinding. Punch out rivet shank using a suitable diameter punch.

(b) Remove lever (5) from bracket on rear face of No. 4 bearing housing cover (1).

(3) JT15D-5 (Post-SB7384) and JT15D-5R engines: remove self-locking nut (35), bolt (32) and lever (5) from bracket on rear face of No. 4 bearing housing cover (1).

(4) Release cable assembly (13) from lever (5) by rotating clevis (7) and pulling shoulder pin (6) from slot in lever. Remove cable assembly.

(5) JT15D -5R (Post-SB7306 and Post-SB7384) and JT15D-5R engines: remove spacer (34) from lever (5). Remove lockwire, bolt (16) and jam nut (15) from lever.

(6) Remove actuating rod (4) from No. 4 bearing housing cover (1). Retain spacer (3) and discard preformed packing (2) or seal (30) or (31).

(7) Remove bellcrank as follows:

(a) JT15D-5 (Pre-SB7306) engines:

1 Pre-SB7281 engines: remove two cotterpins (14) securing headless pin (11). Push out headless pin and remove bellcrank (12) from bracket (10).

2 Post-SB7281: remove cotterpin (21), castellated nut (22) and D-headed bolt (23). Remove bellcrank (12) from bracket (10).

(b) JT15D-5 (Post-SB7306) engines:

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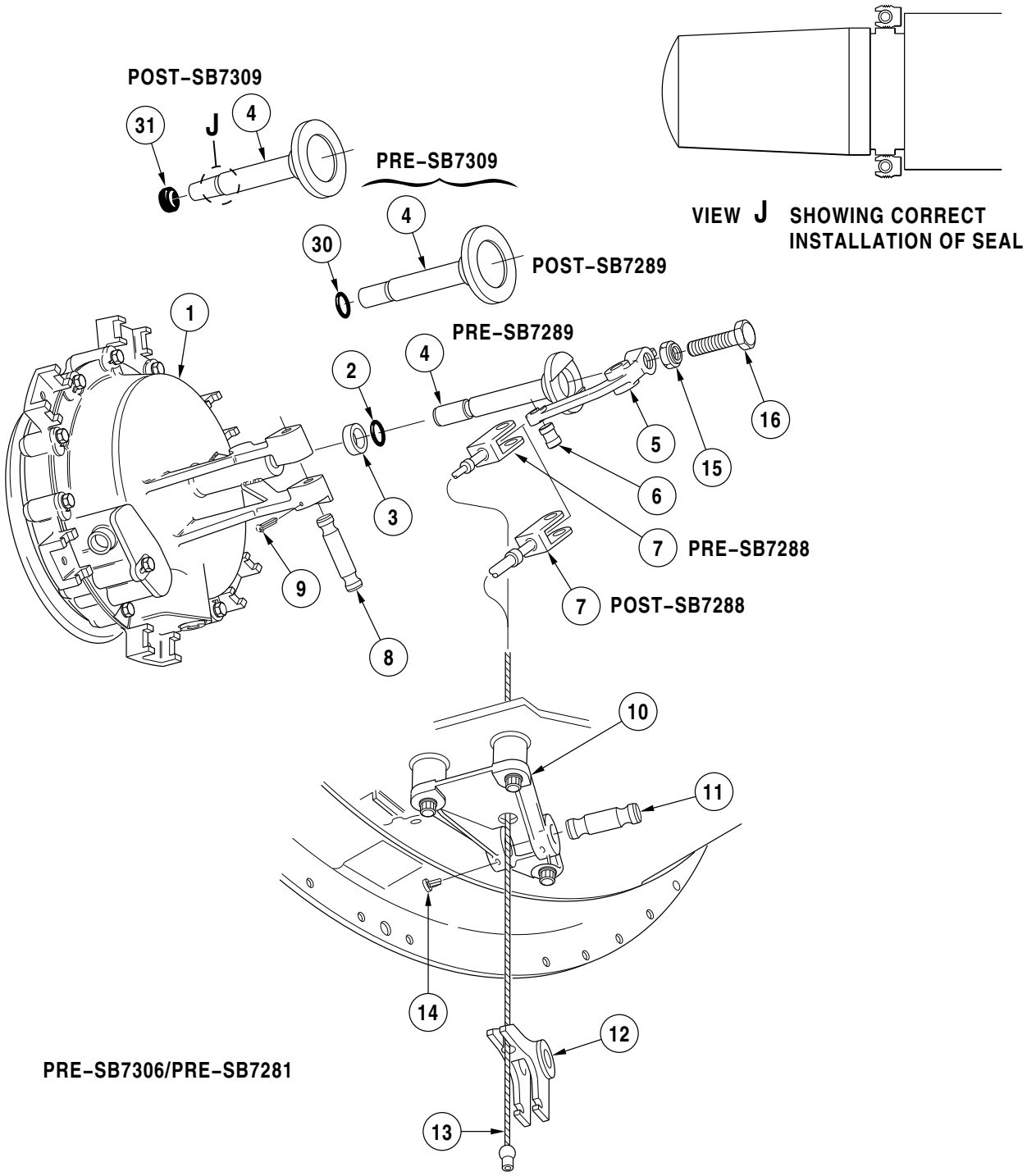

JT15D-5 ONLY

C32455A

Emergency Fuel Shutoff Control Linkage System
Figure 204 (Sheet 1 of 7)

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Key to Figure 204

1. No. 4 Bearing Housing Cover
2. Preformed Packing
3. Actuating Rod Spacer
4. Actuating Rod
5. Lever
6. Shouldered Pin
7. Clevis
8. Headless Pin
9. Cotterpin
10. Overspeed Control Bracket
11. Headless Pin
12. Bellcrank
13. Straight Cable Assembly
14. Cotterpin
15. Jam Nut
16. Bolt
17. Bolt
18. Castellated Nut
19. Cotterpin
20. D-headed Bolt
21. Cotterpin
22. Castellated Nut
23. D-headed Bolt
24. LP Turbine Stator Support
25. Overspeed Control Setting Gage
26. Sleeve Spacer
27. No. 4 Bearing Housing and Cover Assembly
28. Exhaust Duct Assembly
29. T-headed Bolt
30. Seal (Post-SB7289)
31. Seal (Post-SB7309)
32. Bolt
33. Rivet
34. Sleeve Spacer
35. Self-locking Nut

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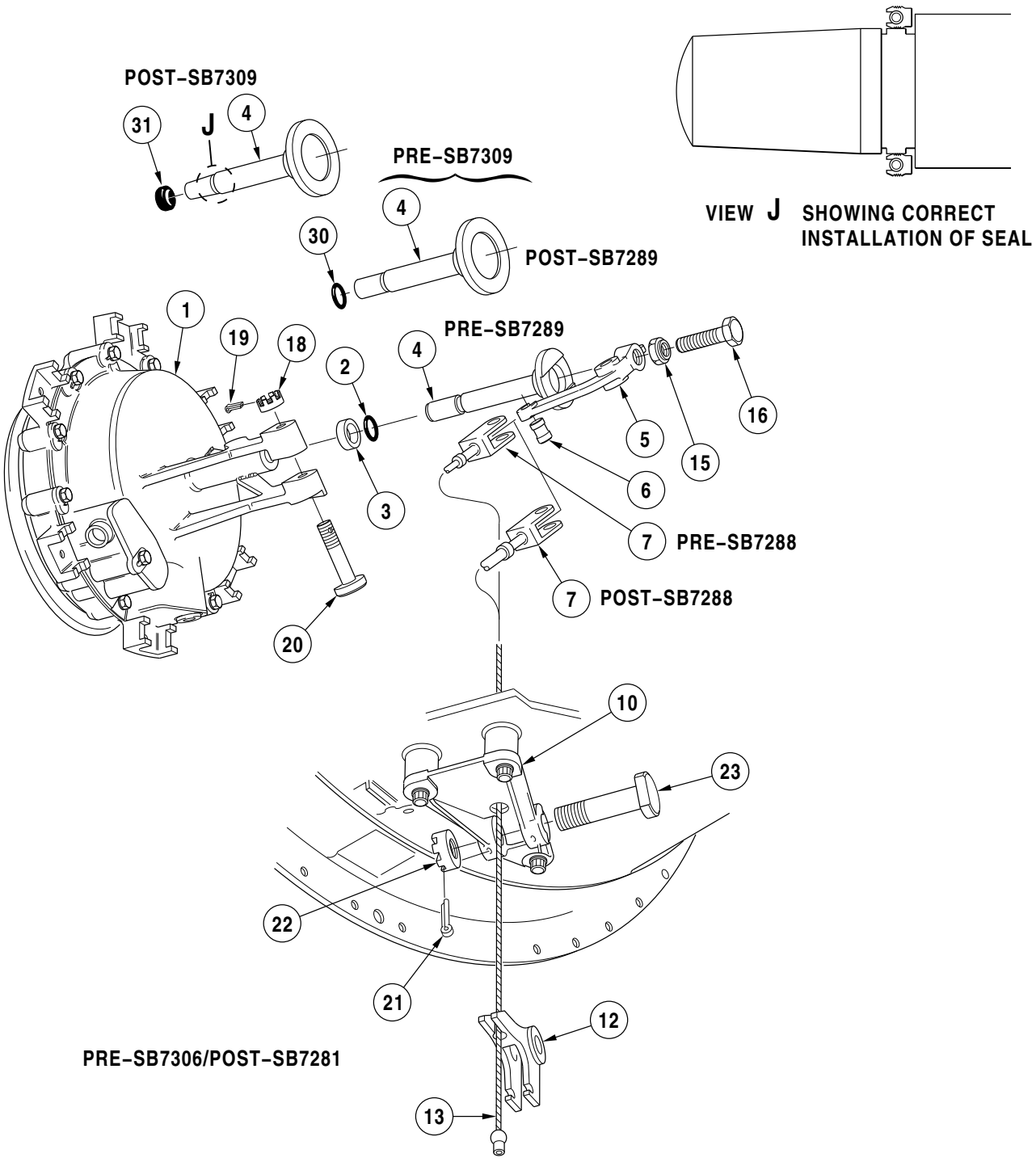

JT15D-5 ONLY

C32458

Emergency Fuel Shutoff Control Linkage System
Figure 204 (Sheet 2)

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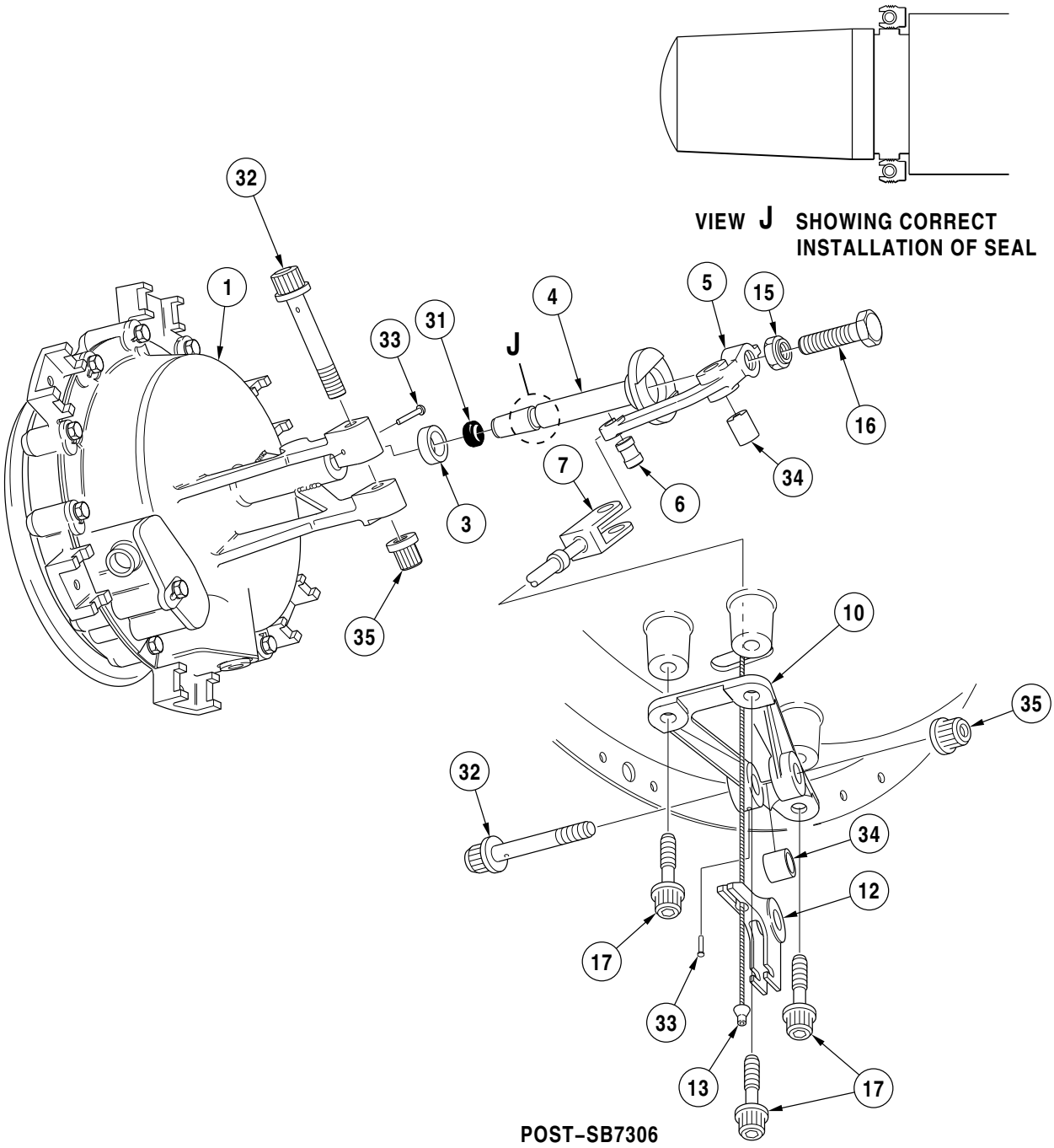

JT15D-5 ONLY

C32457

Emergency Fuel Shutoff Control Linkage System
Figure 204 (Sheet 3)

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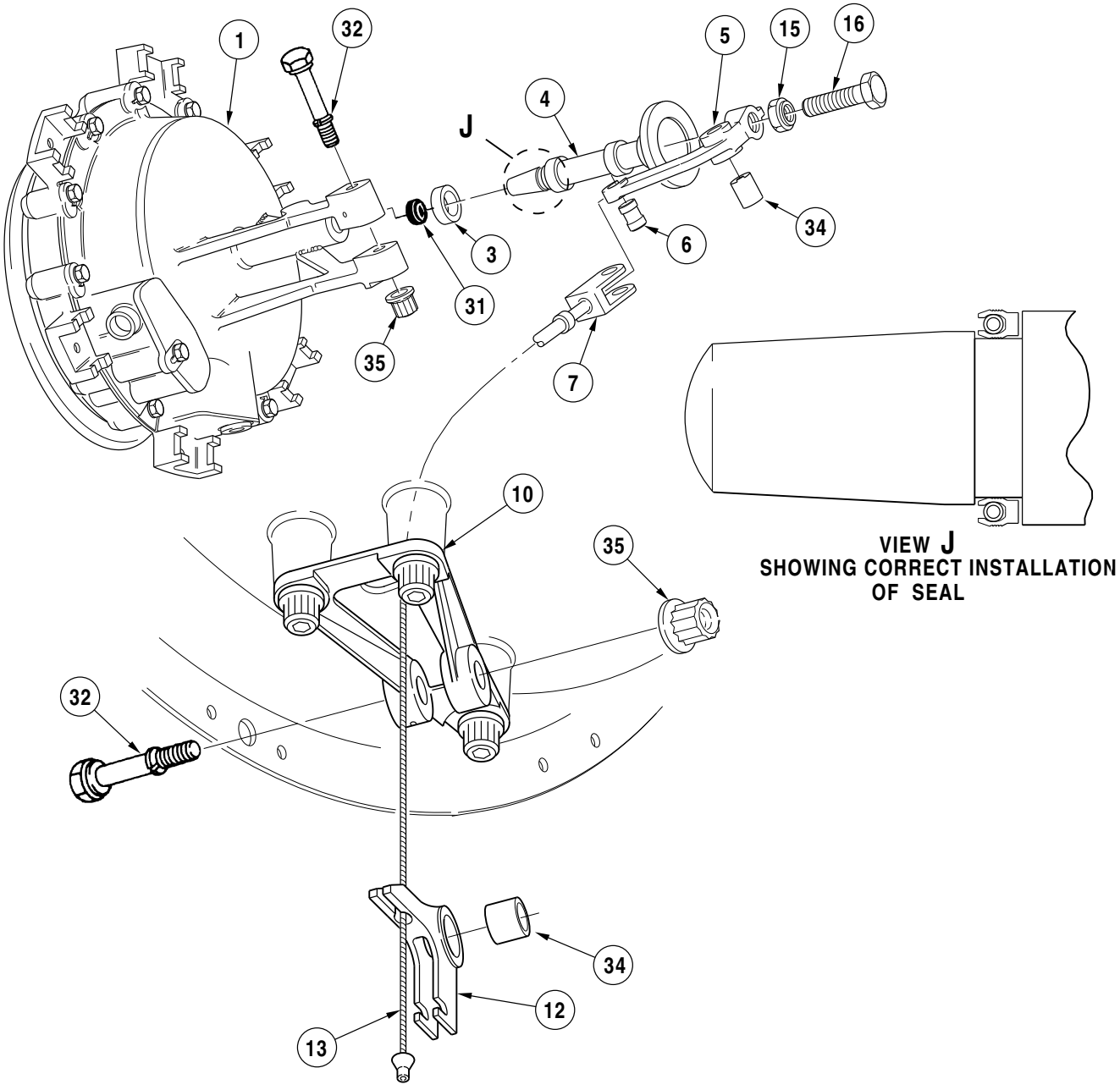

POST–SB7384
JT15D-5 (POST-SB7384) AND JT15D-5R

C34892A

Emergency Fuel Shutoff Control Linkage System
Figure 204 (Sheet 4)

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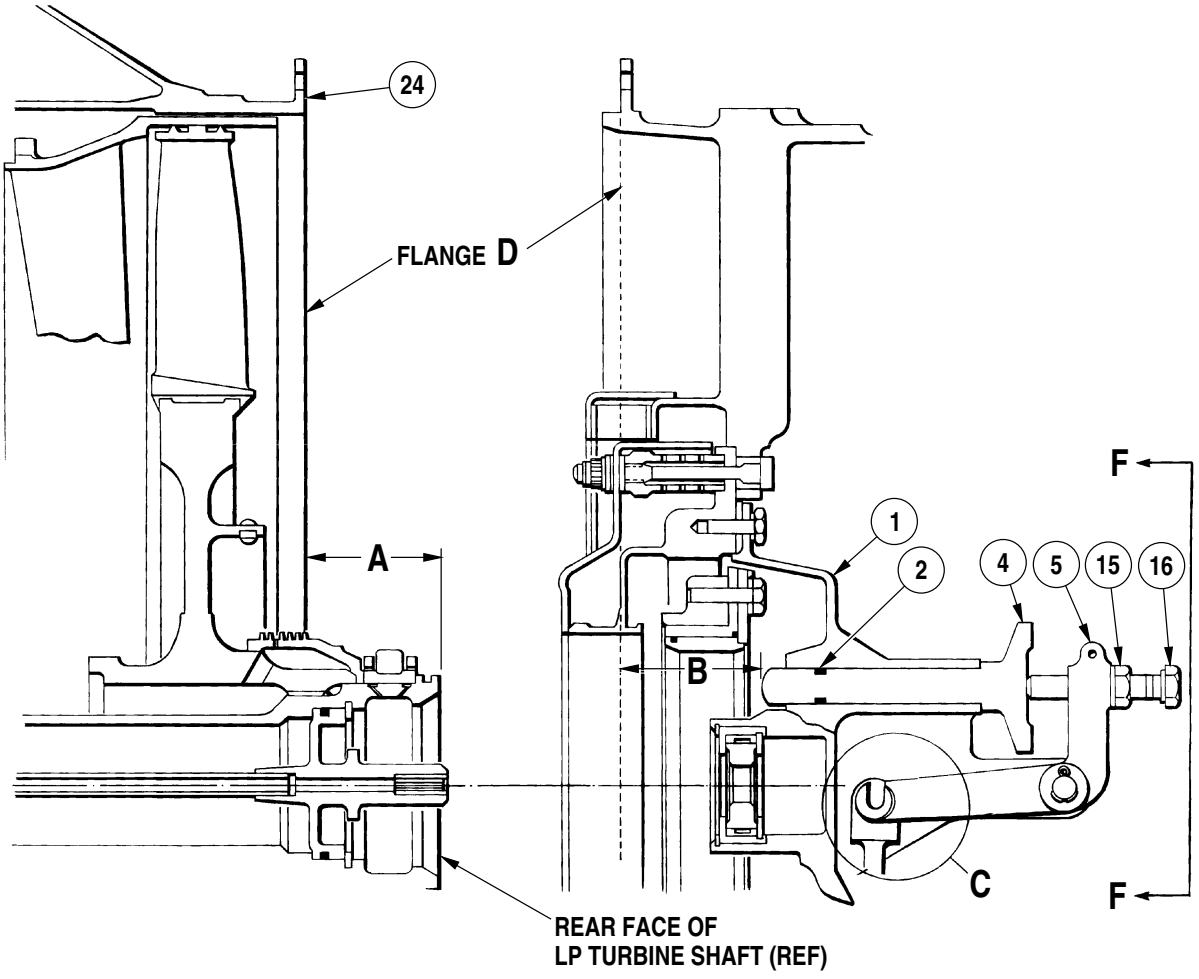

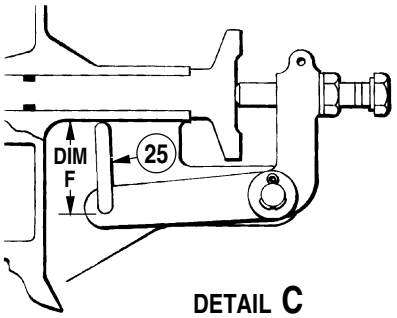

DETAIL C
SHOWN WITHOUT
CABLE INSTALLED

C18805A

Emergency Fuel Shutoff Control Linkage System
Figure 204 (Sheet 5)

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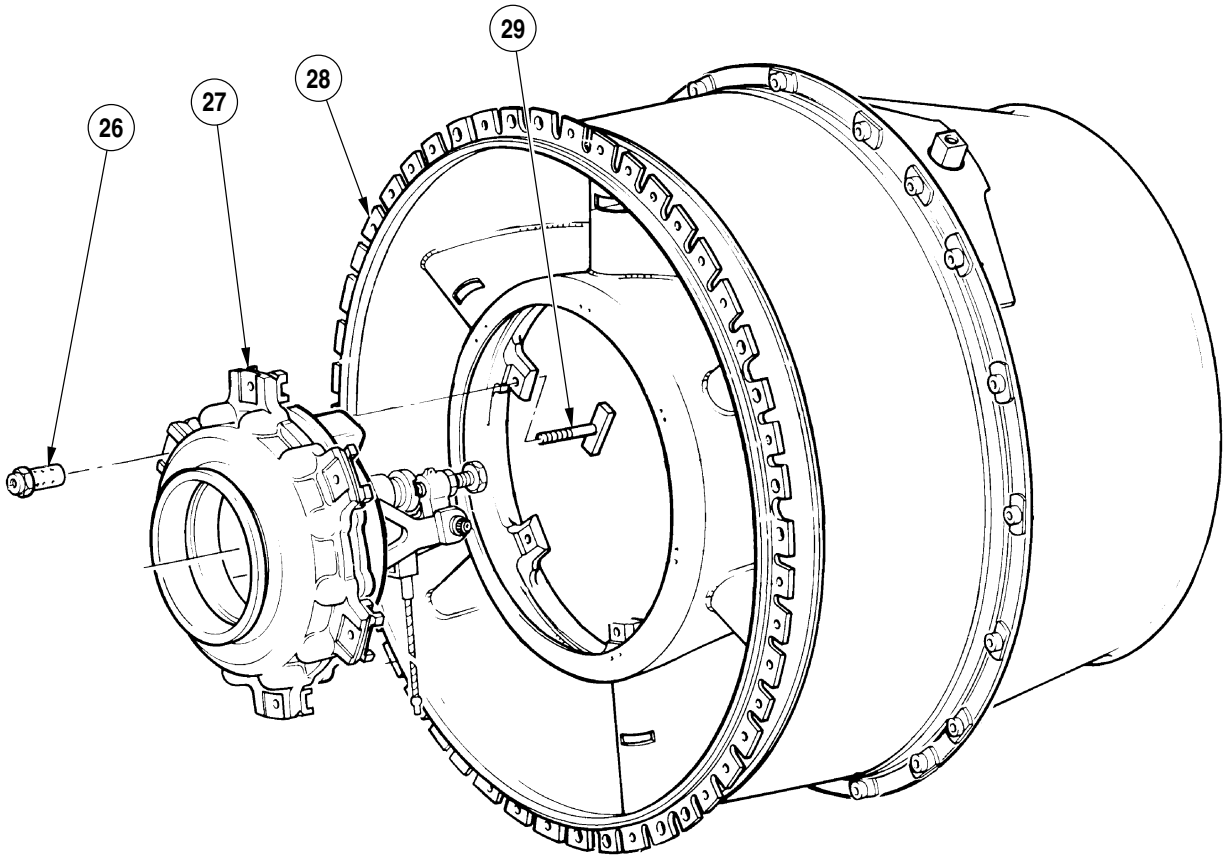

C18804A

Emergency Fuel Shutoff Control Linkage System
Figure 204 (Sheet 6)

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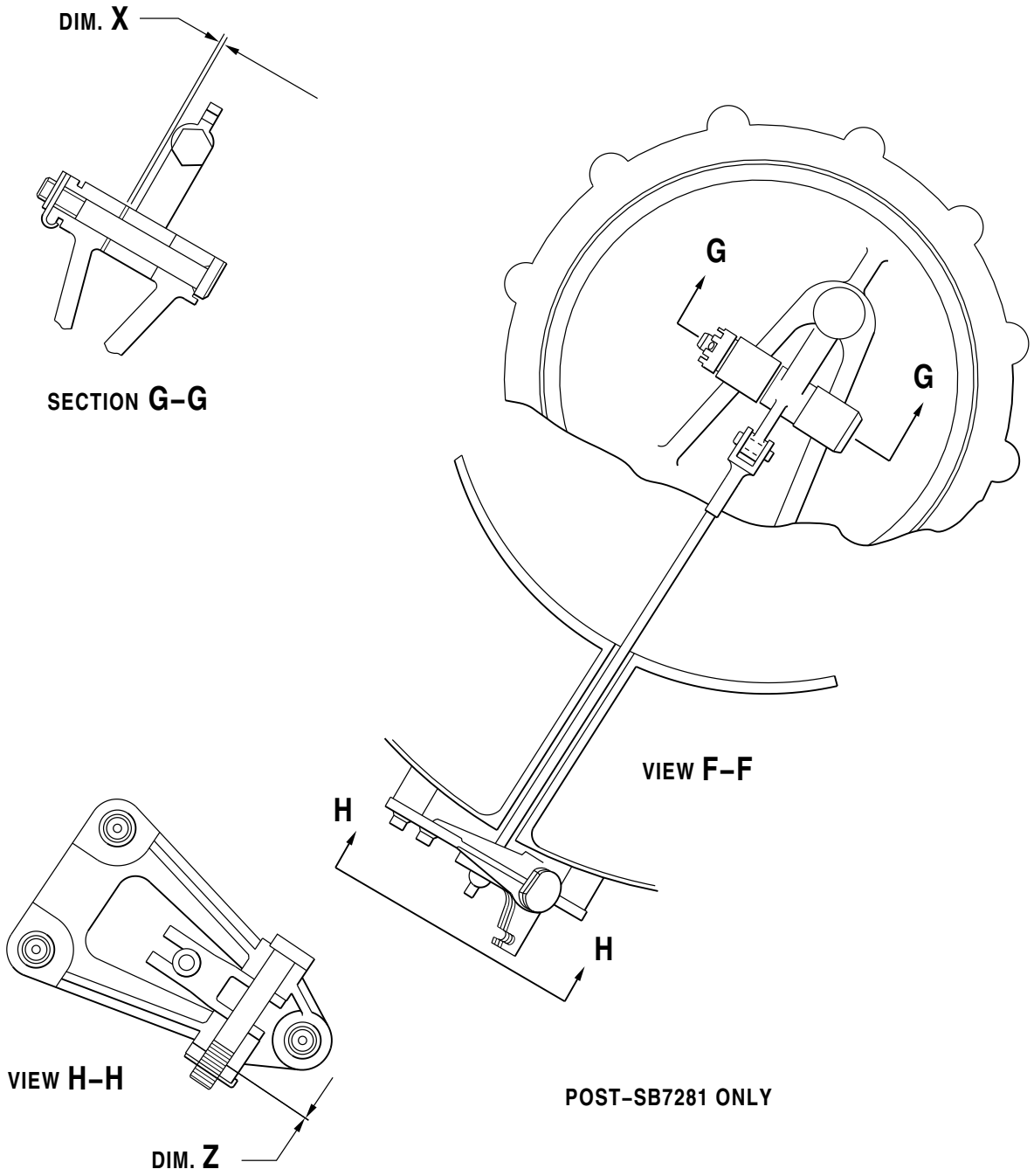

JT15D-5 ONLY

C32456

Emergency Fuel Shutoff Control Linkage System
Figure 204 (Sheet 7)

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1 Remove lockwire and three bolts (17) securing overspeed control bracket (10) and bellcrank (12) to exhaust duct. Remove bracket and bellcrank assembly.

CAUTION: DO NOT DAMAGE PARENT MATERIAL WHEN REMOVING RIVET.

2 Place bracket (10) in a suitable vice. Remove upset head of rivet (33) by grinding. Punch out rivet shank using suitable diameter pin punch.

3 Remove nut (35), bolt (32) and bellcrank (12). Remove spacer (34) from bellcrank.

(c) JT 15D-5 (Post-SB7384) and JT15D-5R engines: remove nut (35), bolt (32) and bellcrank (12). Remove spacer (34) from bellcrank.

F. Installation of Emergency Fuel Shutoff Valve Control Linkage (Ref. Figs. 204 and 205)

NOTE: Refer to Table 201 for fits and clearances.

CAUTION: SPACER THICKNESS MUST BE DETERMINED WHEN REPLACING LP TURBINE ASSEMBLY, NO. 4 BEARING HOUSING COVER OR ACTUATING ROD WITH A NEW OR EXCHANGE PART.

(1) Determine automatic fuel shutoff valve actuating rod spacer thickness as follows:

NOTE: 1. This procedure is required when replacing one of the following with a new exchange part or assembly: LP turbine assembly, No. 4 bearing housing cover, actuating rod or exhaust duct assembly.

NOTE: 2. It is assumed the No. 4 bearing housing and cover are assembled.

(a) Obtain dimension A :

1 Load LP turbine shaft forward and measure distance between LP turbine stator support flange D, and shaft rear face. Record as dimension A.

(b) Determine dimension B as follows:

CAUTION: DO NOT INSTALL SPACER (3), PREFORMED PACKING (2) OR SEAL (31). DO NOT APPLY LUBRICANT.

1 Temporarily install actuating rod (4) in cover (1).

2 Secure cable assembly clevis (7) to slot of overspeed lever (5) using headless shoulder pin (6).

3 JT15D-5 (Pre-SB7306/Pre-SB7281) engines: position and temporarily secure overspeed control lever (5) on No. 4 bearing housing cover (1) with headless shoulder pin (8).

4 JT15D-5 (Pre-SB7306/Post-SB7281) engines: temporarily secure overspeed control lever (5) on No. 4 bearing housing cover (1) with D-headed bolt (20) and castellated nut (18). Tighten nut fingertight.

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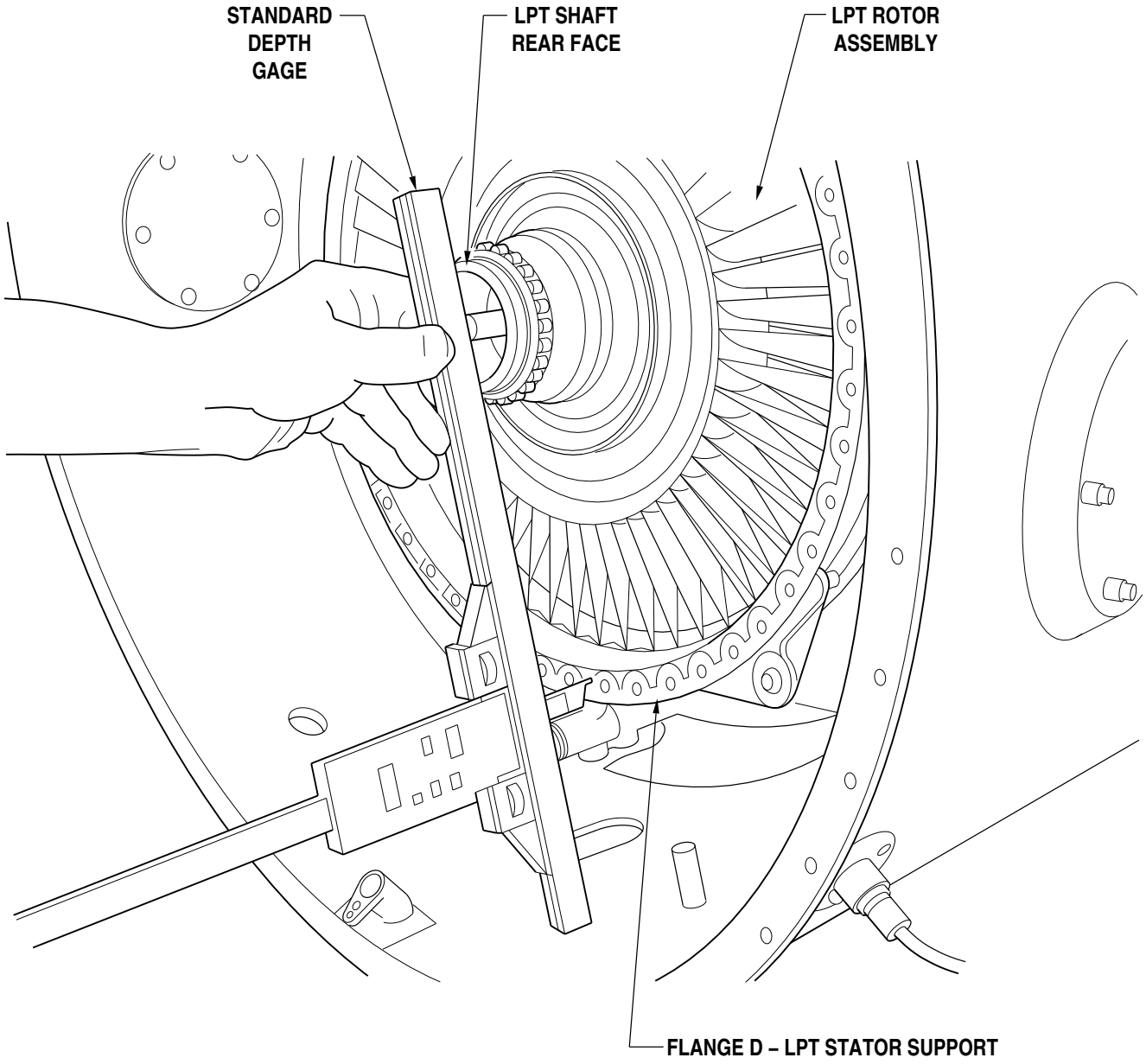

MEASUREMENT OF DIMENSION A (TYPICAL) C70157

Measurement of Dimensions For Automatic Fuel Shutoff Valve Actuating Rod Spacer
Figure 205 (Sheet 1 of 2)

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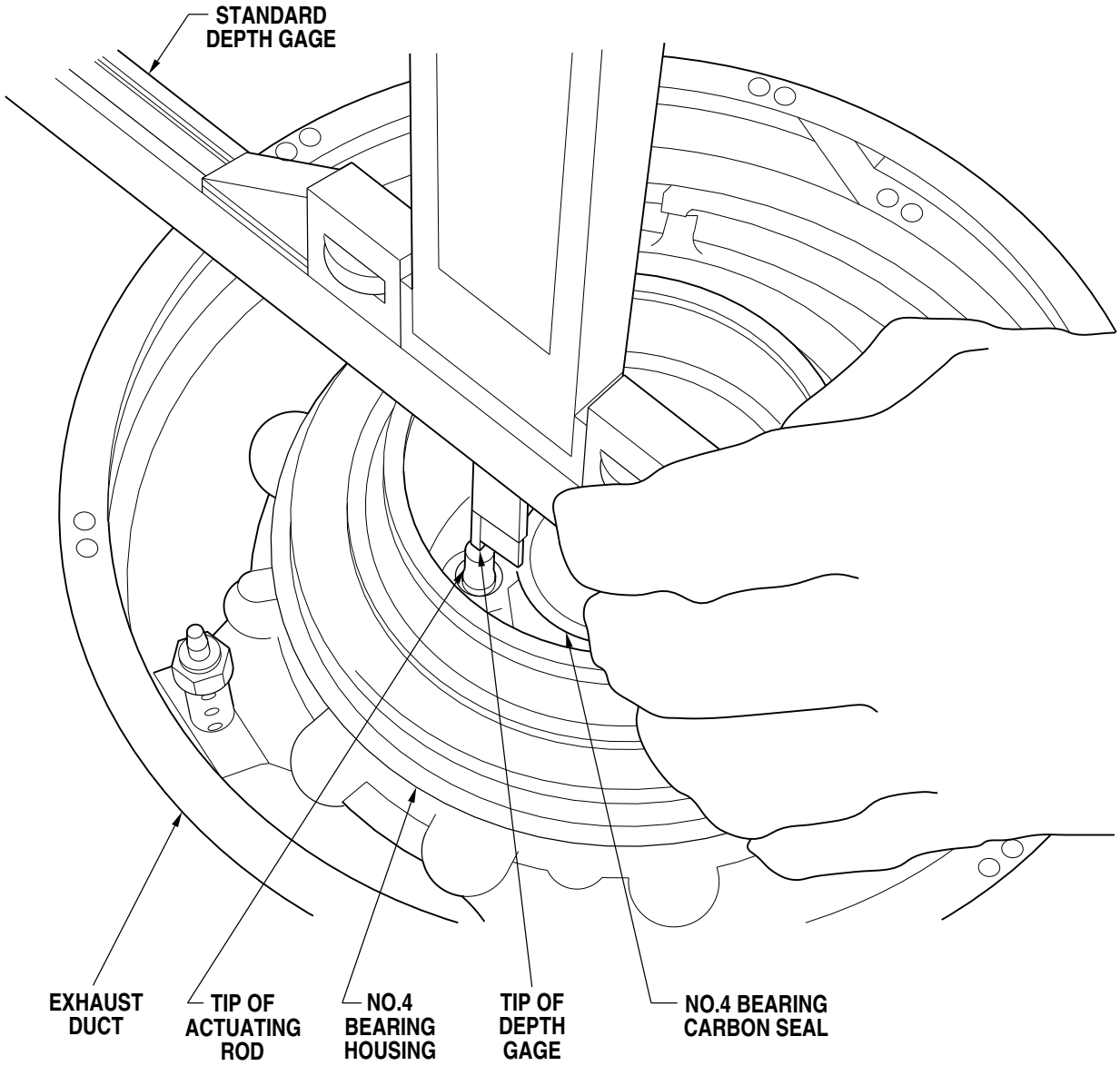

MEASUREMENT OF DIMENSION B (TYPICAL) C70156

Measurement of Dimensions For Automatic Fuel Shutoff Valve Actuating Rod Spacer
Figure 205 (Sheet 2)

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5 JT15D-5 (Post-SB7306) engines:

a Install spacer (34) in overspeed control lever (5) and temporarily secure lever between forks on No. 4 bearing housing cover (1) with bolt (32).

b Temporarily retain bolt by installing lockwire through rivet holes in bolt and No. 4 bearing housing cover. Do not install self-locking nut (35).

6 JT15D-5 (Post-SB7384) and JT15D-5R engines: install spacer (34) in overspeed control lever (5) and temporarily secure lever between forks on No. 4 bearing housing cover (1) with bolt (32). Do not install self-locking nut (35).

(c) Thread jam nut (15) on bolt (16) and screw bolt onto overspeed control lever (5).

(d) While guiding cable assembly (13) through strut at seven o'clock position of exhaust duct (28), position bearing housing and cover assembly (27) on exhaust duct mounting lugs.

(e) Using holder (PWC31642), temporarily install six T-headed bolts (29) and sleeve spacers (26) to secure housing assembly to exhaust duct. Seat housing assembly by torquing spacers 42 to 44 lb.in.

(f) Ensure that actuating rod (4) is correctly seated by pulling cable assembly (13) radially outward at the exhaust duct. Maintain tension on cable and measure dimension B .

(g) Calculate required spacer thickness according to the following formula:

(Dim. A + 0.068 in.) - Dim. B = spacer thickness

1 Grind spacer (3) to calculated thickness. Faces of spacer must be parallel within 0.0002 in.

(h) Remove temporarily installed sleeve spacers (26), bearing housing assembly (27) and T-headed bolts (29).

(i) Remove hardware temporarily securing lever to No. 4 bearing housing cover (1).

(j) Remove shoulder pin (6) and cable (13) then remove lever (5) from No. 4 bearing housing cover (1).

(k) Remove actuating rod (4) from No. 4 bearing housing cover (1).

CAUTION: DO NOT APPLY LUBRICANT ON ACTUATING ROD. LUBRICANT MAY BECOME COKED, PREVENTING FREE TRAVEL OF ROD.

(2) Install actuating rod (4) as follows:

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(a) JT15D-5 (Pre-SB7309) engines: install required spacer (3) on rod (4). Install new preformed packing (2) or seal (30) on actuating rod (4), then install rod in No. 4 bearing housing cover (1).

(b) JT15D-5 (Post-SB7309 and Post-SB7384) and JT15D-5R engines: install required spacer (3) on rod (4). Install new seal (31) on seal guide (PWC60769-1). Push seal into groove in actuating rod (4) with seal pusher (PWC60769-2). Remove pusher and guide, then install re-sizer (PWC60769-3) over seal in rod groove. Keep re-seizer installed for five minutes, then remove. Install rod in No. 4 bearing housing cover (1).

(3) JT15D-5 (Pre-SB7306/Pre-SB7281) engines:

(a) Position lever (5) between fork of mounting bracket on No. 4 bearing housing cover (1). Align holes in lever and bracket. Insert headless pin (8) and secure with two cotterpins (9).

(b) Install overspeed control setting gage (25) (PWC31661) in notch in overspeed lever (5) (Ref. Detail C). Adjust bolt (16) until gage touches cover, establishing reference dimension of 1.117 to 1.127 in. Remove gage and torque jam nut (15) 65 to 85 lb.in. while holding bolt. Lockwire bolt and jam nut to lever.

(c) Connect cable assembly (13) to lever (5) by installing shoulder pin (6) in clevis (7) and inserting pin in lever slot.

(d) Position No. 4 bearing housing assembly (27) on exhaust duct (28) and feed cable assembly (13) through strut at 7 o'clock position. Ensure that mating faces are in full, even contact and secure No. 4 bearing housing assembly in accordance with Subpara. D..

(4) JT15D-5 (Pre-SB7306/Post-SB7281) engines:

(a) Position lever (5) between fork of mounting bracket on No. 4 bearing housing cover (1). Align holes in lever and bracket. Install D-headed bolt (20) and castellated nut (18).

(b) Tighten castellated nut (18) until there is a clearance of 0.005 inch between lever (5) and cover at dimension X. Secure with cotterpin (19).

(c) Stake bolt (20) thread using a punch. Stake between nut (18) castellations in two opposite directions, ensuring that a minimum of one thread is flattened flush with bolt shank.

(d) Install overspeed control setting gage (25) (PWC31661) in notch in overspeed lever (5) (Ref. Detail C). Adjust bolt (16) until gage touches cover, establishing reference dimension of 1.117 to 1.127 in. Remove gage and torque jam nut (15) 65 to 85 lb.in. Lockwire bolt and jam nut to lever.

(e) Connect cable assembly (13) to lever (5) by installing shoulder pin (6) in clevis (7) and inserting pin in lever slot.

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(f) Position No. 4 bearing housing assembly (27) on exhaust duct (28) and feed cable assembly (13) through strut at 7 o'clock position. Ensure that mating faces are in full, even contact and secure No. 4 bearing housing assembly in accordance with Subpara. D..

(5) JT15D-5 (Post-SB7306) engines:

(a) Install spacer (34) in overspeed control lever (5). Position lever between fork of mounting bracket on No. 4 bearing housing cover (1). Install bolt (32) and nut (35). Thread nut loosely onto bolt.

(b) Connect cable assembly (13) to lever (5) by installing shoulder pin (6) in clevis (7) and inserting pin in lever slot.

(c) Align rivet hole in No. 4 bearing housing cover (1) with rivet hole in bolt (32) using a 0.062 inch diameter drift. With drift in place, torque nut 62 to 72 lb.in.

(d) Remove drift and install rivet (33) with manufactured head up. Flare rivet using riveter (PWC31687) and sets (PWC30304-09) and (PWC30304-18).

(e) Install overspeed control setting gage (25) (PWC31661) in notch in overspeed lever (5) (Ref. Detail C). Adjust bolt (16) until gage touches cover, establishing reference dimension of 1.117 to 1.127 in. Remove gage and torque jam nut (15) 65 to 85 lb.in. Lockwire bolt and jam nut to lever.

(f) Install bellcrank (12) as follows:

1 Place overspeed control bracket (10) in a suitable vice.

2 Install spacer (34) in bellcrank (12). Position bellcrank between fork on overspeed control bracket (10) and install bolt (32) and nut (35). Thread nut loosely onto bolt.

3 Align rivet hole in overspeed control bracket (10) with rivet hole in bolt (32) using a 0.062 inch diameter drift. With drift in place, torque nut 62 to 72 lb.in.

4 Remove drift and install rivet (33) with manufactured head oriented as shown on Figure 204. Flare rivet using riveter (PWC31687) and sets (PWC30304-09) and (PWC30304-18). Remove assembly from vice.

(g) Position No. 4 bearing housing assembly (27) on exhaust duct (28) and feed cable assembly (13) through strut at 7 o'clock position. Ensure that mating faces are in full, even contact and secure No. 4 bearing housing assembly in accordance with Subpara.D..

(h) Engage ball end of cable assembly (13) with socket of bellcrank (12). Position bracket assembly on exhaust duct (28) mounting boss and secure with three bolts (17). Torque bolts 24 to 36 lb.in. and lockwire.

(6) JT15D-5 (Post-SB7384) and JT15D-5R engines:

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(a) Install spacer (34) in overspeed control lever (5). Position lever between fork of mounting bracket on No. 4 bearing housing cover (1). Install bolt (32) and nut (35). Torque nut 85 to 95 lb.in.

(b) Install overspeed control setting gage (25) (PWC31661) in notch in overspeed lever (5) (Ref. Detail C). Adjust bolt (16) until gage touches cover, establishing reference dimension of 1.117 to 1.127 in. Remove gage and torque jam nut (15) 85 to 95 lb.in. Lockwire bolt and jam nut to lever

(c) Connect cable assembly (13) to lever (5) by installing shoulder pin (6) in clevis (7) and inserting pin in lever slot.

(d) Install spacer (34) in bellcrank (12). Position bellcrank between fork on overspeed control mounting bracket (10) and install bolt (32) and nut (35). Torque nut 85 to 95 lb.in.

(e) Position No. 4 bearing housing assembly (27) on exhaust duct (28) and feed cable assembly (13) through strut at 7 o'clock position. Ensure that mating faces are in full, even contact and secure No. 4 bearing housing assembly in accordance with Subpara.D..

G. Disassembly of No. 4 Bearing Housing and Cover (Ref. Fig. 202)

(1) Separate and disassemble No. 4 bearing housing and cover as follows:

(a) Unlock 12 keywashers (15) and remove 12 bolts (16), (19) and (20). Separate No. 4 bearing housing (1) and cover (14). Remove and discard JT15D-5 (Pre-SB7308) gasket (11) or JT15D-5 (Post-SB7308) or JT15D-5R seal (28).

(b) Remove oil tube (12) from cover (14) and discard two preformed packings (13).

(c) Remove retaining ring (24) from pressure oil entry port and extract strainer (25). Clean and inspect strainer (Ref. Para. 7. and Para. 6.).

NOTE: Retaining ring may be removed with a length of lockwire formed into a hook and entered through one of the holes in the ring.

(2) Inspect No. 4 bearing housing (1) to determine whether further disassembly is required (Ref. Para. 6.).

(3) If inspection requirements are not met, disassemble No. 4 bearing housing (1) as follows:

CAUTION: HANDLE NO. 4 BEARING OUTER RACE WITH CARE WEARING CLEAN, LINT-FREE GLOVES.

(a) Unlock three keywashers (9) and remove three bolts (10) securing retaining ring (8), No. 4 bearing outer race (7) and bearing sleeve (6). Remove retaining ring (8) and outer race (7) from sleeve (6). Note serial number of bearing and tag LP turbine rotor set accordingly, to avoid mixing bearing components at reassembly.

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(b) Remove No. 4 bearing sleeve (6) from bearing housing (1) using drift (PWC52111).

(4) Inspect No. 4 bearing housing cover (14) to determine if further disassembly is required (Ref. Para. 6.).

(5) If inspection requirements are not met, disassemble No. 4 bearing housing cover (14) as follows:

(a) Remove emergency fuel shutoff valve control linkage (Ref. Subpara. E.).

(b) Remove No. 4 bearing carbon seal (Ref. Para. 8.).

H. Assembly of No. 4 Bearing Housing and Cover (Ref. Fig. 202)

CAUTION: BEFORE ASSEMBLY, MAKE CERTAIN THAT ALL INTERNAL OIL PASSAGES AND OIL JETS IN COVER ARE FREE FROM OBSTRUCTION.

CAUTION: CAREFULLY INSPECT THE CARBON SEAL ASSEMBLY LOCATED IN THE BEARING HOUSING COVER FOR SECURITY, CLEANLINESS AND FREEDOM FROM DAMAGE.

(1) JT15D-5 (Pre-SB7308) engines only: soak new gasket (11) in engine oil (PWC03-001) for 30 minutes minimum.

(2) Install strainer (25) in input port of cover (14) and secure with retaining ring (24).

(3) Heat No. 4 bearing housing (1) in oven at 205°C (400°F) for 15 to 20 minutes.

(4) Remove No. 4 bearing housing (1) from oven. Place on bench with mounting lugs facing up. Align scallop on No. 4 bearing sleeve (6) with oil inlet port on housing and install sleeve using drift (PWC52112).

(5) Make sure outer race serial number matches tag on LP turbine rotor set.

(6) Allow No. 4 bearing housing (1) to cool to room temperature. Install preformed packing (27) in groove at bottom of No. 4 bearing sleeve (6).

CAUTION: HANDLE NO. 4 BEARING OUTER RACE WITH CARE, WEARING CLEAN, LINT-FREE GLOVES.

(7) Place No. 4 bearing outer race (7) on bench with anti-rotation tangs facing up. Lubricate outer race packing groove with engine oil (PWC03-001). Install preformed packing (26) on outer race.

(8) Align retaining ring (8) anti-rotation slots and tangs on No. 4 bearing outer race (7) with retaining ring packing groove facing down. Engage tangs and slots and press ring firmly onto outer race with even contact on mating faces. Install assembly in housing with retaining ring scallop aligned with housing oil inlet port.

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(9) Install three keywashers (9) and bolts (10). Tighten bolts 24 to 36 lb.in. but do not lock keywashers. Check placement of preformed packing (26) using a 0.001 inch feeler gage. Gage must not enter between retaining ring (8) and No. 4 bearing sleeve (6) at three bolt locations.

NOTE: If feeler gage enters fit, remove bolts (10) and keywashers (9) and retaining ring (8) with preformed packing (26) and bearing outer race (7). Separate retaining ring and outer race and check that packing is correctly seated. Repeat steps (7) through (9).

(10) Lock keywashers (9).

(11) Clean contact faces of housing (14) and cover (1) with acetone (PWC11-012).

(12) JT15D-5 (Pre-SB7308) engines:

(a) Lubricate No. 4 bearing outer race (7) with engine oil (PWC03-001) and heat housing assembly at 149°C (300°F) for five minutes. Remove from oven.

(b) Install two new preformed packings (13) on oil transfer tube (12). Install tube in oil inlet port on No. 4 bearing housing (1).

(c) Install gasket (11) or seal (28) on No. 4 bearing housing (1) and mate with cover (14). Secure with 12 keywashers (15), 10 bolts (16), one bolt (19) and one bolt (20).

(d) Tighten and torque bolts (16, 19, 20) 42 to 44 lb.in. using a star pattern. Do not lock keywashers and allow housing and cover assembly to stand for ten minutes.

(e) Apply second torque of 42 to 44 lb.in. to all bolts (16, 19, 20) using star pattern. If any bolt is not fully tightened, repeat steps (d) and (e) until torque holds.

(13) JT15D-5 (Post-SB7308) and JT15D-5R engines:

(a) Temporarily mate housing (1) and cover (14) to check for possible interference. If interference fit is present, lubricate No. 4 bearing outer race (7) with engine oil (PWC03-001) and heat housing in an oven at 250 to 300 °F for five minutes. Remove from oven.

(b) Apply a thin film of joining compound (PWC09-005) to mating faces of housing (1) and cover (14).

NOTE: Do not apply sealant to area where seal (28) is to be installed.

(c) Install two new preformed packings (13) on oil transfer tube (11). Install tube in oil inlet port on No. 4 bearing housing (1).

(d) Install seal (28) on No. 4 bearing housing (1) and mate with cover (14).

(e) Install 12 keywashers (15), one bolt (10), one bolt (20) and 10 bolts (16).

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(f) Tighten and torque bolts (16, 19, 20) 44 to 46 lb.in. using a star pattern. Do not lock keywashers. If heated, allow assembly to cool to room temperature. Allow housing and cover assembly to stand for five minutes before second torque.

(g) Apply second torque of 39 to 46 lb.in. to all bolts (16, 19, 20) using star pattern (REF. NO. 1748, Table 202). If any bolt is not fully tightened, repeat steps (f) and (g) until torque holds.

(14) Install emergency fuel shutoff valve control linkage.

6. Inspection/Check

A. Exhaust Duct

(1) Inspect exhaust duct for cracks, distortion and impact damage (Ref. Fig. 206) .

(2) One circumferential or axial crack, evident in View A, is acceptable up to two inches in length, subject to a maximum of three affected zones of which not more than two may be adjacent. Through-cracks which extend beyond the fillet radius should be repaired. Refer to Paragraph 8., following.

(3) One axial crack, evident in View B, is acceptable up to one inch in length. A through-crack should be repaired. Refer to Paragraph 8., following.

(4) JT15D-5 (Pre-SB7425) engines: two cracks up to 2 inches long, provided they are a minimum of 3 inches apart, propogating from rear edge of exhaust duct are allowable. For repair, refer to Paragraph 8., following.

(5) JT15D-5 (Post-SB7425/Pre-SB7471) engines: Inspect rear duct

(a) A maximum of 5 axial cracks up to 1.500 inches long and separated by at least two inches of undamaged metal are allowable. Cracks within allowable limits must be stop-drilled (Ref. Para. 8.).

(b) T-shaped cracks or cracks which turn through 90 degrees are not permitted.

(6) JT15D-5 (Post-SB7501 and Post-SB7471) and JT15D-5R engines: Inspect stiffening ring and blend nicks, burrs and raised metal. Damage up to 0.025 inch deep is permitted. Cracks are not permitted on stiffening ring.

(7) JT15D-5 (Post-SB7472) engines: check torque of exhaust duct band retaining bolts. No rotation of band is permitted.

(8) Reject exhaust ducts which do not meet allowable limits in steps (2) through (7).

B. Exhaust Duct Borescope Plug Lockwire Tab

(1) Inspect welded borescope port plug lockwire tab on rear cone of exhaust duct. Repair broken tab by replacement (Ref. Repair).

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C. No. 4 Bearing Housing

(1) Inspect Area d for damage from LP turbine rotor air seal (Ref. Fig. 206). Damage to 0.006 inch is allowed. If damage is greater, reject housing.

(2) Evidence of oil coking on interior and exterior of bearing housing.

(3) Security of three bolts securing bearing retaining ring.

(4) Disposition of housing is as follows:

(a) If housing meets all inspection requirements in steps (1) through (3), no further disassembly of housing is required. Perform external cleaning if required.

(b) If housing does not meet inspection requirements, disassemble in accordance with Paragraph 5.G..

(5) Clean No. 4 bearing housing (Ref. Para. 7.).

(6) Reassemble No. 4 bearing housing (Ref. Para. 5.H.).

D. No. 4 Bearing Housing Cover Assembly

(1) Inspect No. 4 bearing housing cover assembly to determine if further disassembly is required as follows:

(a) Check No. 4 bearing carbon seal in cover. If cracks, chips or other damage are visible, reject carbon seal.

(b) Check for oil coking on interior of No. 4 bearing housing cover, in particular on and around exposed tip of actuating rod.

(c) Check scavenge oil outlet and pressure oil inlet ports for blockage.

(d) Check that overspeed control lever on No. 4 bearing housing cover fork moves freely.

(e) Remove lockwire securing jam nut and bolt on overspeed control lever. Remove jam nut and bolt from lever. From interior of cover, push exposed tip of actuating rod to check freedom of movement. Rod must slide freely.

(f) If any of these inspection criteria are not met, proceed as follows:

1 Disassemble No. 4 bearing housing cover (Ref. Para. 5.G.).

2 Remove and discard preformed packing or seal from emergency fuel shutoff actuating rod. Clean and inspect actuating rod (Ref. Para. 7. and Subpara. H.).

3 Clean bearing housing cover (Ref. Para. 7.).

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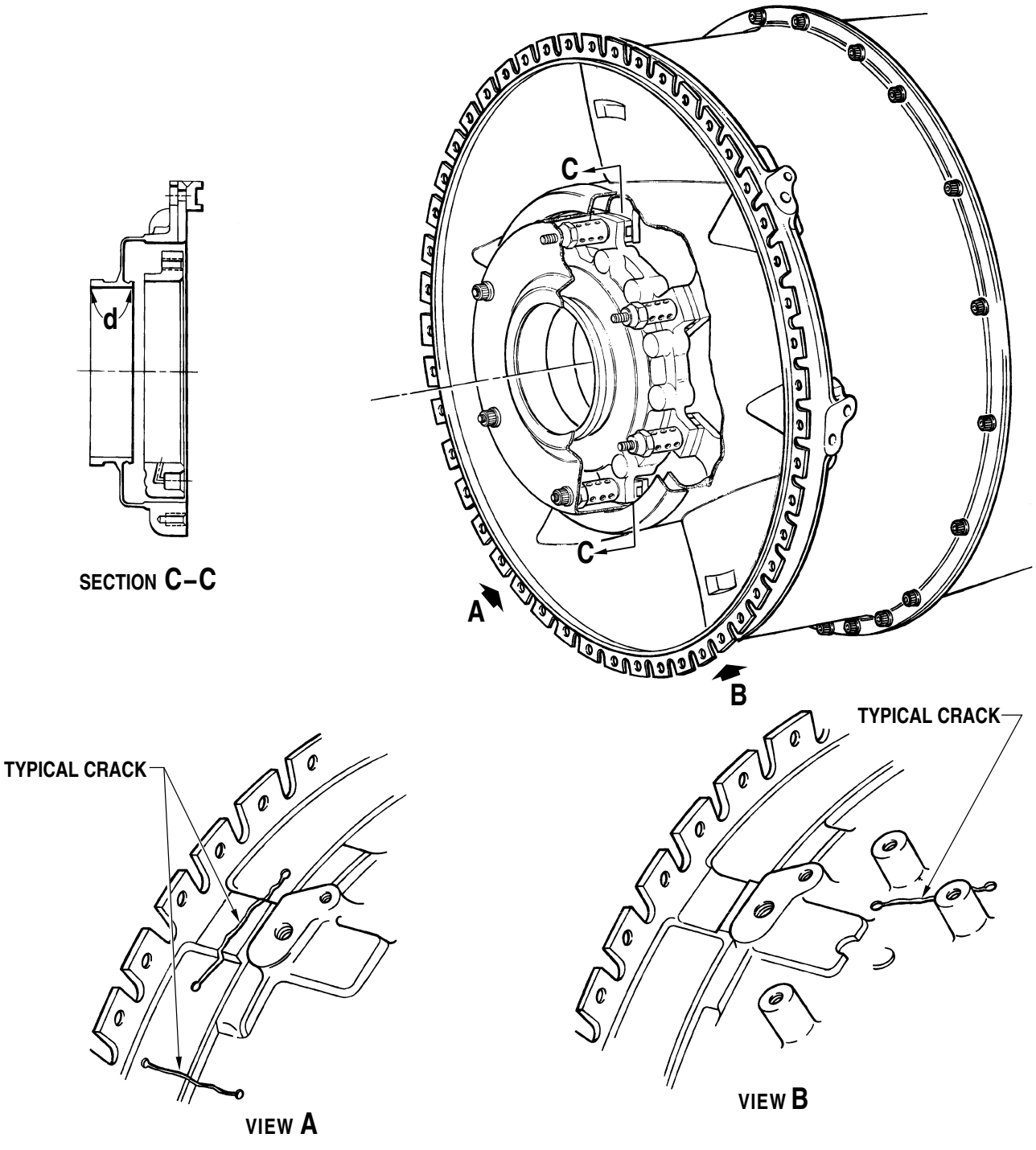

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Exhaust Duct - Inspection
Figure 206 (Sheet 1 of 2)

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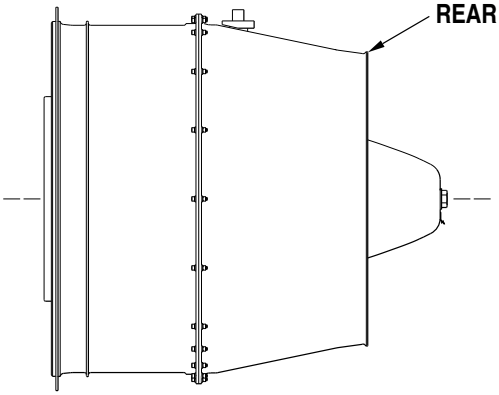
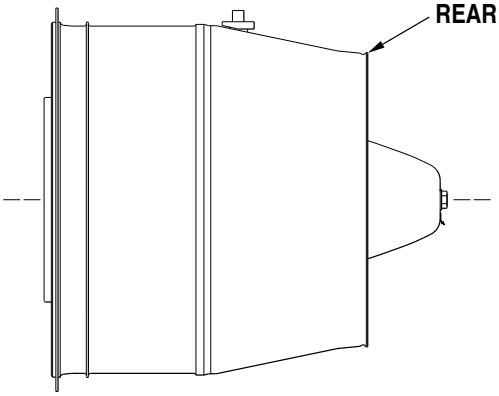


JT15D–5 (PRE–SB7425)



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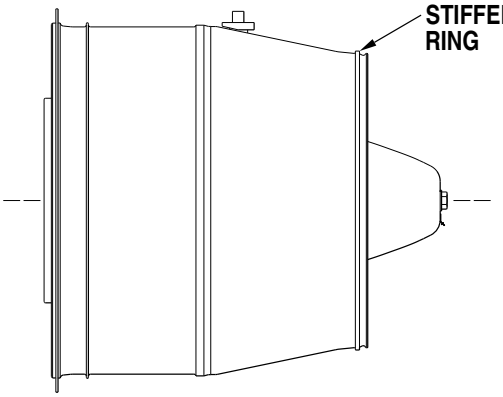
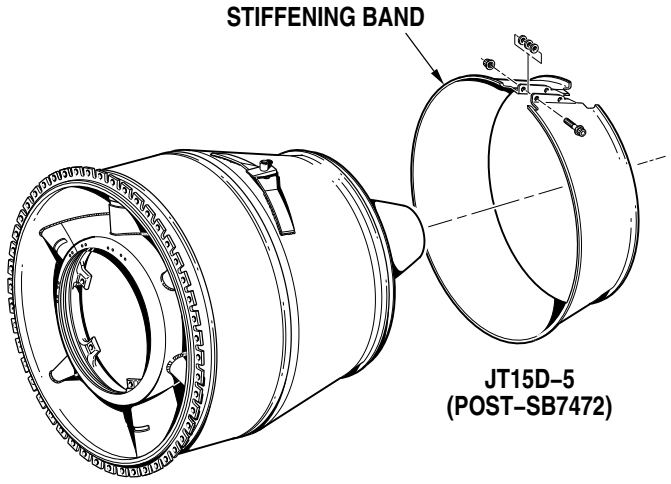


JT15D–5 (POST–SB7471 / SB7501)
AND JT15D–5R



JT15D–5
(POST–SB7472)

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Exhaust Duct - Inspection
Figure 206 (Sheet 2)

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4 Using a suitable light source, inspect actuating rod bore in cover. Bore must be free of nicks and contamination. Reject cover with nicks in bore, or blend nicks in actuating rod bore and flush to remove contamination (Ref. Para. 7.).

5 Visually inspect cover oil passages: no obstruction or contamination is allowed. Flush cover oil passages to remove obstruction or contamination (Ref. Para. 7.).

6 Visually inspect cover for cracks or burrs on cover/housing mating flange as follows:

a Cracks: no cracks are allowed. Reject cover.

b Burrs on cover mating flange are not allowed. Reject cover.

7 Install serviceable No. 4 bearing carbon seal in bearing housing cover (Ref. Para. 8.). Install emergency fuel shutoff control linkage (Ref. Subpara. 5.F.).

E. No. 4 Bearing Housing/Exhaust Duct Lug Mating Faces

(1) Inspect No. 4 bearing housing/exhaust duct lug mating faces for evidence of fretting wear.

(2) Accept wear on each part, without repair, up to a maximum of 0.005 inch.

(3) Parts exhibiting lug wear beyond these limits should be returned to an approved overhaul facility for possible repair.

F. Exhaust Duct T6 Thermocouple Installation

(1) Inspect installation for condition (Ref. 77-00-02).

(2) Check installation for heat response (Ref. 77-00-02).

G. No. 4 Bearing Oil Nozzle Strainer Element

(1) Inspect element (Fig. 202) for general condition.

(2) Inspect element for broken wires, trapped particles and condition of brazing. Broken wires are not acceptable.

H. Actuating Rod

NOTE: The following inspection is associated with No. 4 bearing housing cover inspection.

(1) Inspect actuating rod as follows (Ref. Fig. 207):

(a) Check spherical tip of rod. Tip should show no scoring or wear.

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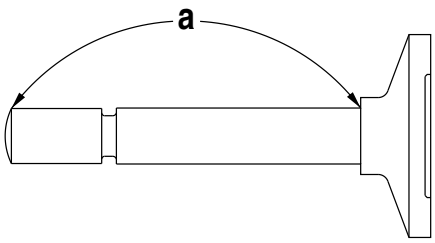
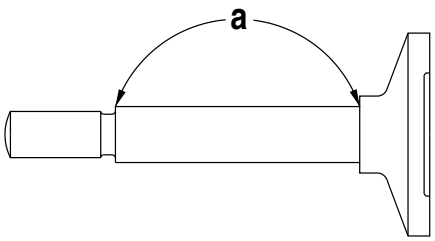
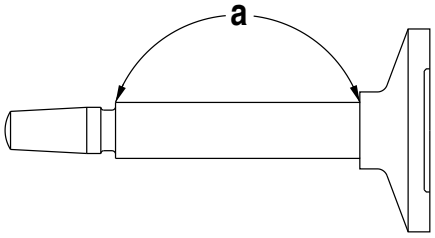


PRE-SB7289
PRE-SB7309



POST-SB7289
PRE-SB7309



POST-SB7309

JT15D-5

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Actuating Rod - Inspection
Figure 207

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(b) Check rod barrel and face which mates with cover. Burrs, scratches or raised metal are not acceptable.

(c) After No. 4 bearing housing cover has been cleaned, insert rod in cover. Ensure rod slides freely, without binding.

(d) JT15D-5 (Pre-SB7309 and Post-SB7309) engines only: no loss of anti-galling compound at area a is permitted.

(e) Reject and replace actuating rod which does not meet requirements (a) through (d).

7. Cleaning and Painting

CAUTION: WEAR EYE AND HAND PROTECTION DURING CLEANING OPERATIONS. DO EXTERNAL AND IMMERSION CLEANING ONLY IN A WELL VENTILATED WORKSPACE.

A. No. 4 Bearing Housing

CAUTION: HANDLE No. 4 BEARING OUTER RACE WITH CARE, WEARING CLEAN, LINT-FREE GLOVES.

(1) External Cleaning (Ref. Fig. 202)

(a) Cover pressure oil port and bearing oil jet on No. 4 bearing housing (1) with masking tape (PWC05-068) or install a suitable plug. Cover bearing oil jet with masking tape to prevent entry of cleaning solution.

(b) Mask installed No. 4 bearing outer race (7) to prevent any cleaning solution from contacting bearing.

NOTE: Do not put masking tape on surface of bearing.

(c) Apply carbon remover compound (PWC11-056) to exterior of housing and allow to soak for between one and twelve hours.

(d) Remove carbon deposits from exterior of No. 4 bearing housing (1) using a stiff, nonmetallic bristle brush.

(e) Pressure-rinse exterior of No. 4 bearing housing (1) thoroughly with hot water and dry with clean, dry, filtered compressed air.

(f) Check effectiveness of cleaning and repeat soaking and scrubbing if required. Reapply masking if required.

NOTE: Maximum total soaking time is 24 hours.

(g) Remove masking tape or plug and clean adhesive residue with solvent (PWC11-027).

(h) Flow clean, filtered compressed air through housing oil jet in reverse direction. Ensure all internal passages are dry and free of obstruction.

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(i) Store housing (1) in a clean plastic bag until required.

CAUTION: HANDLE No. 4 BEARING OUTER RACE WITH CARE, WEARING CLEAN, LINT-FREE GLOVES.

(2) Immersion Cleaning (Ref. Fig. 202)

(a) Remove No. 4 bearing retaining ring (8), sleeve (6) and outer race (Ref. Para. G.

(b) Immerse No. 4 bearing housing (1) in carbon remover compound (PWC11-056) for between one and twelve hours. After soaking, remove carbon deposits using a stiff, nonmetallic bristle brush.

(c) Pressure-rinse housing (1) thoroughly internally and externally with hot water and dry with clean, dry, filtered compressed air.

(d) Check effectiveness of cleaning. Repeat soaking and scrubbing if required.

NOTE: Maximum total soaking time is 24 hours.

(e) Flow clean, dry, filtered compressed air through housing oil jet in reverse direction. Ensure all internal passages are dry and free of obstruction.

(f) Install No. 4 bearing retaining ring (8), sleeve (6) and outer race (7) in housing (1) (Ref. Para. H.).

(g) Store housing (1) in a clean plastic bag until required.

B. No. 4 Bearing Housing Cover

(1) External Cleaning (Ref. Fig. 202)

(a) Remove emergency fuel shutoff control linkage and No. 4 bearing carbon seal (22) from No. 4 bearing housing cover (14).

(b) Plug or mask oil tube ports to prevent entry of cleaning solution.

(c) Apply carbon remover compound (PWC11-056) to exterior of cover and allow to soak for one to twelve hours.

(d) Remove carbon deposits from exterior of cover (14) using a stiff nonmetallic bristle brush.

(e) Pressure-rinse exterior of cover (14) thoroughly with hot water and dry with compressed air.

(f) Check effectiveness of cleaning and repeat soaking and scrubbing if required. Reapply masking if required.

NOTE: Maximum total soaking time is 24 hours.

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(g) Flow clean, dry, filtered compressed air through bearing housing cover oil jets in reverse direction. Ensure all oil passages are dry and free of obstruction.

(h) Install carbon seal (22) (Ref. Para. 8.). Install actuating rod and emergency fuel shutoff control linkage. Store cover assembly in a clean plastic bag until required.

(2) Immersion Cleaning (Ref. Fig. 202)

(a) Remove emergency fuel shutoff control linkage from No. 4 bearing housing cover (14).

(b) Remove No. 4 bearing carbon seal (24) from No. 4 bearing housing cover (14).

CAUTION: DO NOT IMMERSE COVER IN CARBON SOLVENT UNLESS CARBON SEAL AND EMERGENCY FUEL SHUTOFF CONTROL LINKAGE HAVE BEEN REMOVED.

(c) Immerse cover (14) in carbon remover compound (PWC11-056) for one to twelve hours. After soaking, remove carbon deposits using a stiff, nonmetallic bristle brush.

(d) Rinse cover (14) exterior thoroughly with hot water, and dry with compressed air.

(e) Check effectiveness of cleaning. Repeat soaking and scrubbing if required.

NOTE: Maximum total soaking time is 24 hours.

(f) Flow clean, dry filtered compressed air through oil jets in cover (14), in reverse direction. Ensure all internal passages are dry and free of obstruction.

(g) Store cover (14) in a clean plastic bag until required.

C. No. 4 Bearing Oil Nozzle Strainer Element

(1) Wash element in clean petroleum solvent (PWC11-027).

(2) Dry element, using clean, dry, filtered compressed air, or allow element to stand and air dry.

D. Actuating Rod

(1) Wipe actuating rod with clean, lint-free cloth moistened with solvent (PWC11-027). If required, soak part in solvent and scrub using nonmetallic bristle brush. Allow rod to dry completely before inspecting.

8. Approved Repairs

A. Exhaust Duct - Cracks

(1) Repair exhaust duct cracks by stop-drilling ends of crack, using a 1/16 (0.0625) inch drill.

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B. Exhaust Duct - Repair for Borescope Plug Lockwire Tab by Replacement (Ref. Fig. 208)

NOTE: The following repair is only applicable to engines incorporating welded borescope plug lockwire tab P/N 3041680-01 (Ref. Illustrated Parts Catalog, P/N 3033444).

(1) Remove exhaust duct from engine (Ref. Subpara. 5.A.).

(2) Place exhaust duct on a suitable work bench with rear cone up.

(3) Remove all safety wire or safety cable between borescope plug and lockwire tab.

CAUTION: WEAR SUITABLE EYE PROTECTION.

CAUTION: DO NOT DAMAGE BORESCOPE PLUG ADAPTER OR SURROUNDING EXHAUST DUCT PARENT METAL.

(4) Use rotary grinding tool to remove damaged borescope plug lockwire tab as close to the weld area as possible.

(5) Prepare exhaust duct borescope plug lockwire tab surface with a wire brush and use isopropyl alcohol (PWC11-014B) to clean surface of oil and dirt.

(6) Clean new borescope plug lockwire tab using isopropyl alcohol (PWC11-014B).

(7) Position borescope plug lockwire tab on exhaust duct as shown on Figure 208 and with lockwire tab at engine 6 o'clock position.

(8) Weld lockwire tab to exhaust duct at 0.125 inch nominal hole with filler wire (PWC05-151) using Tungsten Inert Gas (TIG) method.

(9) Inspect weld for cracks by white light inspection and a 10X magnifying glass.

(10) If removed, install and secure borescope plug in port in exhaust duct (Ref. 72-00-00 INSPECTION - Borescope Inspection: No. 4 Bearing Housing/Overspeed Cointrol Cable).

(11) Install repaired exhaust duct (Ref. Subpara. 5.B.).

C. No. 4 Bearing Carbon Seal - Repair by Replacement (Ref. Fig. 202)

(1) Using circlip pliers, remove carbon seal retaining ring (23).

(2) Using puller (PWC31274) remove and discard No. 4 bearing carbon seal (22) from No. 4 bearing housing cover (14).

WARNING: PUT ON PROTECTIVE GLOVES WHEN HANDLING HOT PARTS TO PREVENT PERSONAL INJURY.

(3) Put the bearing housing cover (1) in oven, pre-heated to 176°C (350°F) for 10 minutes.

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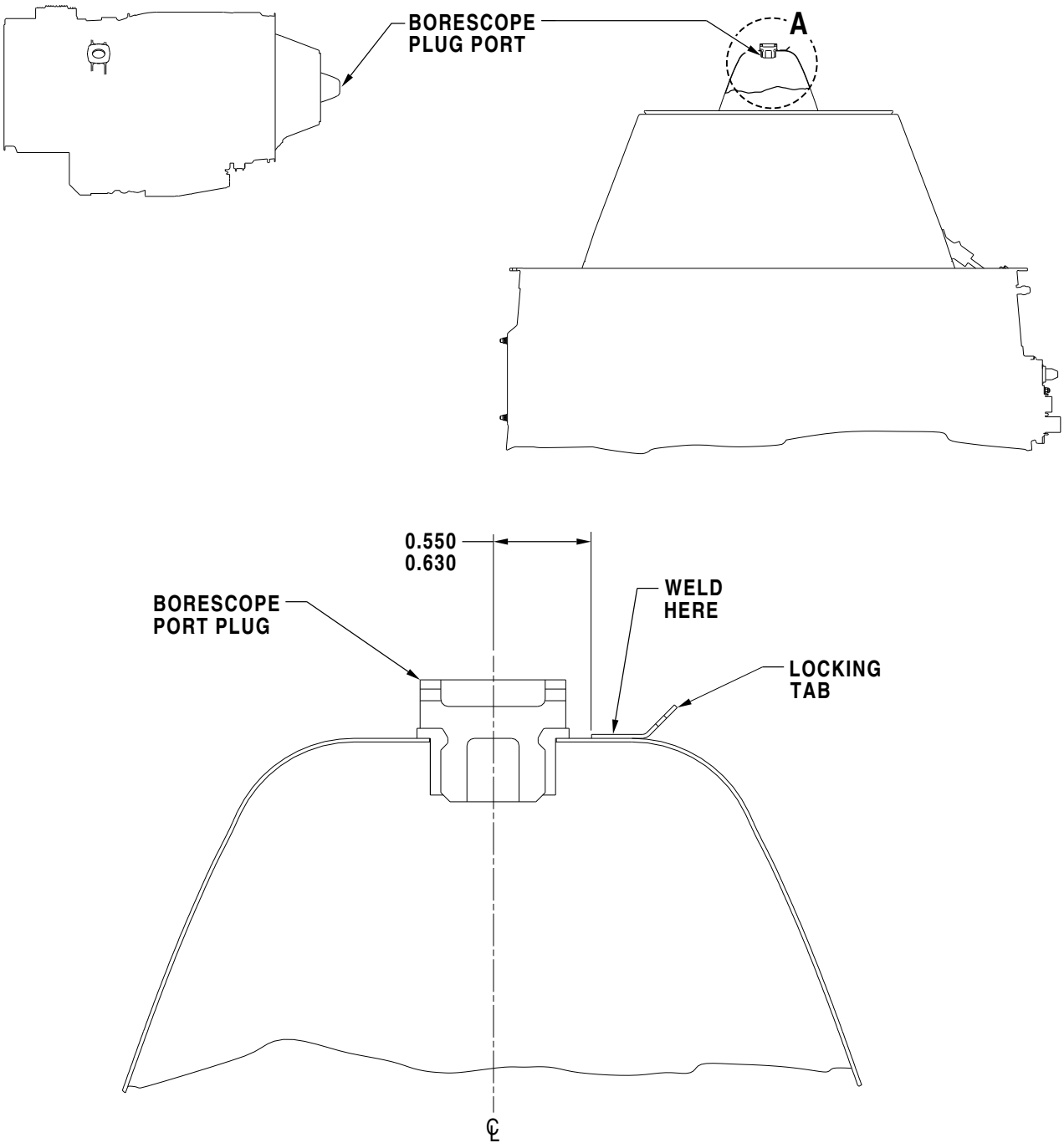

Repair for Borescope Plug Lockwire Tab by Replacement
Figure 208

CAUTION: DO NOT FREEZE REPLACEMENT CARBON ASSEMBLY PRIOR TO INSTALLATION. FREEZING MAY CAUSE CARBON TO CRACK.

(4) Place heated cover (14) in base (PWC31572) and install replacement carbon seal assembly, using drift (PWC31563). Ensure words “THIS SIDE UP” are visible after installation.

(5) Install new retaining ring (23).

9. Fits, Clearances and Torque Loadings

A. Refer to Tables 201 and 202, and Figure 209.

TABLE 201, Fits and Clearances

REF. NO.	Name	Dim. for Ref. (inches)		Limits (inches)		
		Min.	Max.	Min.	Max.	Replace
1116	Duct, Turbine Exhaust Assembly	15.5510	15.5540	0.0040	0.0100	
	Support Assembly, Low Pressure Turbine Stator	15.5580	15.5610			
1117	Cover, No. 4 Bearing Housing	5.3580	5.3600	0.0000	0.0040	
	Housing, No. 4 Bearing, Assembly of	5.3600	5.3620			
1120	Housing, No. 4 Bearing Assembly	7.8300	7.8310	0.0000	0.0020	
	Duct, Turbine Exhaust	7.8310	7.8320			
1122	Seal, Air No. 4 Bearing Housing Rotor	3.4810	3.4840	0.0050	0.0100	
	Housing, No. 4 Bearing Assembly	3.4890	3.4910			
1126	JT15D-5 (Pre-SB7319) Bearing, Roller Cylindrical	3.4950	3.4960	0.0055	0.0075	
	Sleeve, No. 4 Bearing	3.5015	3.5025			

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TABLE 201, Fits and Clearances (Cont'd)

REF. NO.	Name	Dim. for Ref. (inches) Min.	Dim. for Ref. (inches) Max.	Limits (inches) Min.	Limits (inches) Max.	Limits (inches) Replace
1126	JT15D-5 (Post-SB7319) and JT15D-5R Bearing, Roller Cylindrical	3.4950	3.4960	0.0110	0.0130	
	Sleeve, No. 4 Bearing	3.5070	3.5080			
1171	JT15D-5 (Post-SB7384) Rod, Actuating Overspeed Control	0.4090	0.4100	0.0050	0.0080	
	Cover, No. 4 Bearing Housing	0.4150	0.4170			
1175	Pin, Straight, Headed	0.1840	0.1860	0.0020	0.0060	
	Housing, Overspeed Control Linkage	0.1880	0.1900			
1178	JT15D-5 (Pre-SB7306 and Pre-SB7281) Pin, Straight, Headless	0.2460	0.2480	0.0020	0.0060	
	Bracket, Overspeed Control Linkage	0.2500	0.2520			
1178	JT15D-5 (Pre-SB7306 and Post-SB7281) Bolt, D-head	0.2470	0.2490	0.0010	0.0050	
	Bracket, Overspeed Control Linkage	0.2500	0.2520			
1178	JT15D-5 (Post-SB7306 and Post-SB7384) and JT15D-5R Bolt	0.2480	0.2490	0.0010	0.0040	
	Bracket, Overspeed Control Linkage	0.2500	0.2520			
1180	Bolt,	0.2460	0.2480	0.0020	0.0060	
	Bracket, Overspeed Control Linkage	0.2500	0.2520			

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TABLE 201, Fits and Clearances (Cont'd)

REF. NO.	Name	Dim. for Ref. (inches) Min.	Dim. for Ref. (inches) Max.	Limits (inches) Min.	Limits (inches) Max.	Limits (inches) Replace
1181	Pin, Shoulder, Headless	0.1840	0.1860	0.0020	0.0060	
	Lever, Overspeed Control	0.1880	0.1900			
1182	JT15D-5 (Pre-SB7306 and Pre-SB7281) Pin, Straight, Headless	0.2460	0.2480	0.0020	0.0060	
	Cover, No. 4 Bearing Housing	0.2500	0.2520			
1182	JT15D-5 (Pre-SB7306 and Post-SB7281) Bolt, D-head	0.2470	0.2490	0.0010	0.0050	
	Cover, No. 4 Bearing Housing	0.2500	0.2520			
1182	JT15D-5 (Post-SB7306 and Post-SB7384) and JT15D-5R Bolt	0.2480	0.2490	0.0010	0.0040	
	Cover, No. 4 Bearing Housing	0.2500	0.2520			
1183	JT15D-5 (Pre-SB7306 and Pre-SB7281) Pin, Straight, Headless	0.2460	0.2480	0.002	0.0060	
	Lever, Overspeed Control	0.2500	0.2520			
1183	JT15D-5 (Pre-SB7306 and Post-SB7281) Bolt, D-head	0.2470	0.2490	0.0010	0.0050	
	Lever, Overspeed Control	0.2500	0.2520			
1183	JT15D-5 (Post-SB7306 and Post-SB7384) and JT15D-5R Bolt,	0.2480	0.2490	0.0005	0.0030	
	Spacer, Sleeve	0.2495	0.2510			

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TABLE 201, Fits and Clearances (Cont'd)

REF. NO.	Name	Dim. for Ref. (inches) Min.	Dim. for Ref. (inches) Max.	Limits (inches) Min.	Limits (inches) Max.	Limits (inches) Replace
1222	Pin, Shoulder, Headless	0.1350	0.1370	0.0020	0.0060	
	Bellcrank, Overspeed Control	0.1390	0.1410			
1223	Bearing, Plain, Spherical	0.4682	0.4687	0.0005	0.0030	
	Connector, Rod End	0.4692	0.4712			
1224	Pin, Shoulder, Headless	0.1530	0.1550	0.0005	0.0030	
	Bearing, Plain Spherical	0.1555	0.1560			
1225	JT15D-5 (Pre-SB7306 and Pre-SB7281) Pin, Straight, Headless	0.2460	0.2480	0.0020	0.0060	
	Spacer, Sleeve	0.2500	0.2520			
1225	JT15D-5 (Pre-SB7306 and Post-SB7281) Bolt, D-head	0.2470	0.2490	0.0010	0.0050	
	Spacer, Sleeve	0.2500	0.2520			
1225	JT15D-5 (Post-SB7306 and Post-SB7384) and JT15D-5R Bolt	0.2480	0.2490	0.0005	0.0030	
	Spacer, Sleeve	0.2495	0.2510			
1268	Tube, Intershaft Transfer, Assembly	0.4240	0.4250	0.0010	0.0025	
	Seal, Carbon No. 4 Bearing	0.4260	0.4265			

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TABLE 201, Fits and Clearances (Cont'd)

REF. NO.	Name	Dim. for Ref. (inches) Min.	Dim. for Ref. (inches) Max.	Limits (inches) Min.	Limits (inches) Max.	Limits (inches) Replace
1270	JT15D-5 (Pre-SB7425) Duct, Turbine Exhaust Assembly	15.3810	15.3850	0.0010	0.0100	
	Duct, Turbine Exhaust Rear Assembly	15.3750	15.3800			
1316	Sleeve, No. 4 Bearing	4.8540	4.8550	0.0010	0.0030	
	Ring, No. 4 Bearing Retaining	4.8520	4.8530			
1317	Sleeve, No. 4 Bearing	3.7495	3.7500	0.0005T	0.0015T	
	Housing, No. 4 Bearing Assembly	3.7485	3.7490			
1318	Heatshield, No. 4 Bearing			0.0040T	0.0350T	
	Housing, No. 4 Bearing Assembly					
1341	JT15D-5 (Post-SB7306 and Post-SB7384) and JT15D-5R Spacer, Sleeve	0.3540	0.3550	0.0010	0.0040	
	Lever, Overspeed Control	0.3560	0.3580			
1342	JT15D-5 (Post-SB7306 and Post-SB7384) and JT15D-5R Spacer, Sleeve	0.3540	0.3550	0.0010	0.0040	
	Lever, Overspeed Cover	0.3560	0.3580			

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TABLE 202, Torque and Stretch

REF. NO.	Name	Limits Min.	Limits Max.
1731	Plug, Exhaust Duct Borescope Port (Refer to NOTE) NOTE: Apply compound (PWC06-032) to threads of plug. Torque plug 25 to 35 lb.in.		
1734	Heatshield Nuts (Refer to NOTE) NOTE: Torque nuts in pairs in sequence shown on Figure 209 to 42 to 44 lb.in.		
1748	No. 4 Bearing Housing/Cover Bolts (Refer to NOTE) NOTE: Torque housing/cover bolts in pairs in sequence shown in Figure 209 to 42 to 44 lb.in., loosen to 0 lb.in., then retorque to 39 to 46 lb.in.		
1749	Sleeve Spacers (Refer to NOTE) NOTE: Torque sleeve spacer in pairs in sequence shown in Figure 209 to 42 to 44 lb.in., loosen to 0 lb.in., then retorque to 32 to 36 lb.in.		

TABLE 203, Spring Pressure

REF. NO.	Name	Limits Min.	Limits Max.
Not Applicable			

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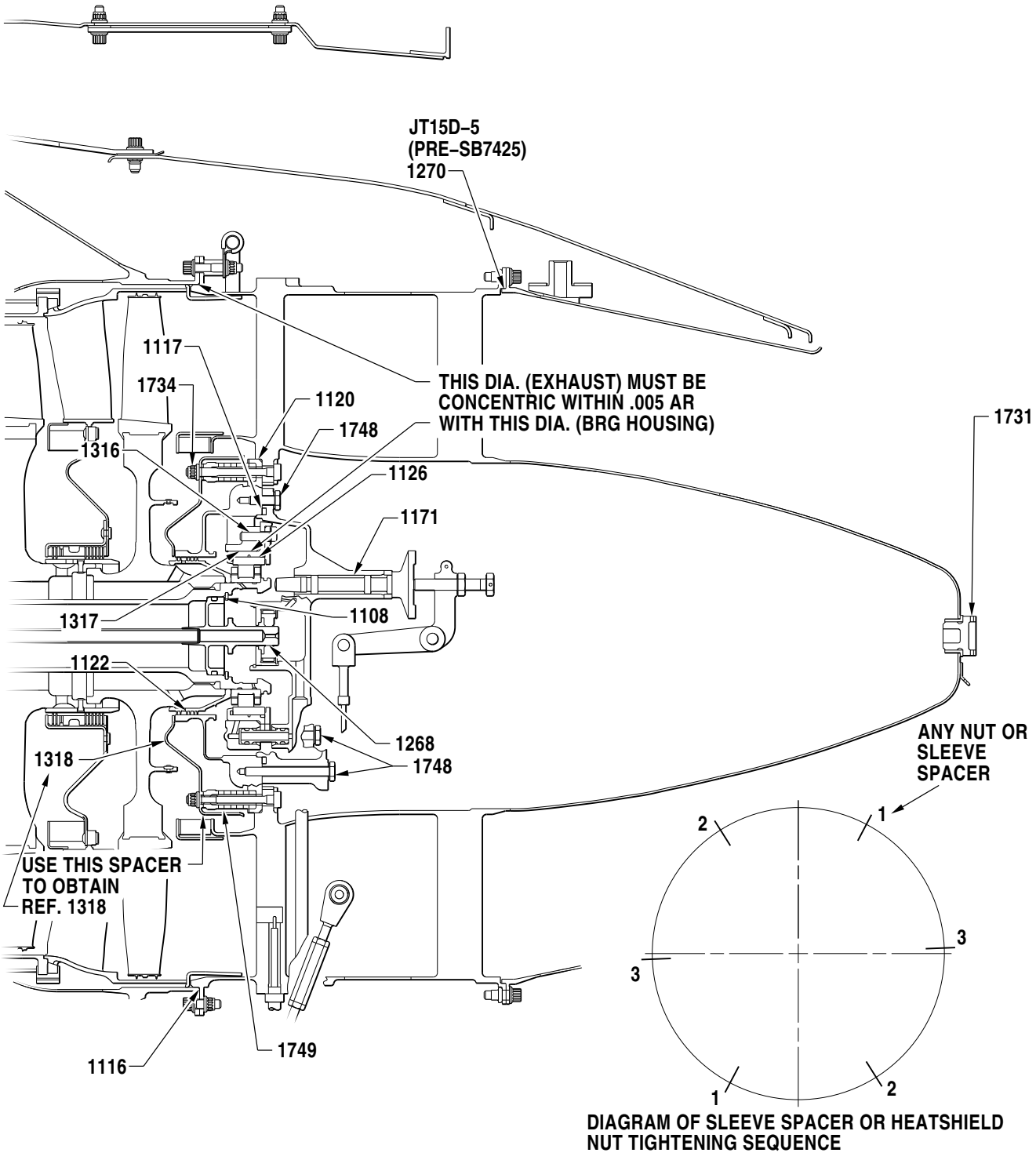
TABLE 204, Special Assembly

REF. NO.	Name	Limits Min.	Limits Max.
Not Applicable			



C178719

Fits, Clearances and Torque Loadings
Figure 209 (Sheet 1 of 4)

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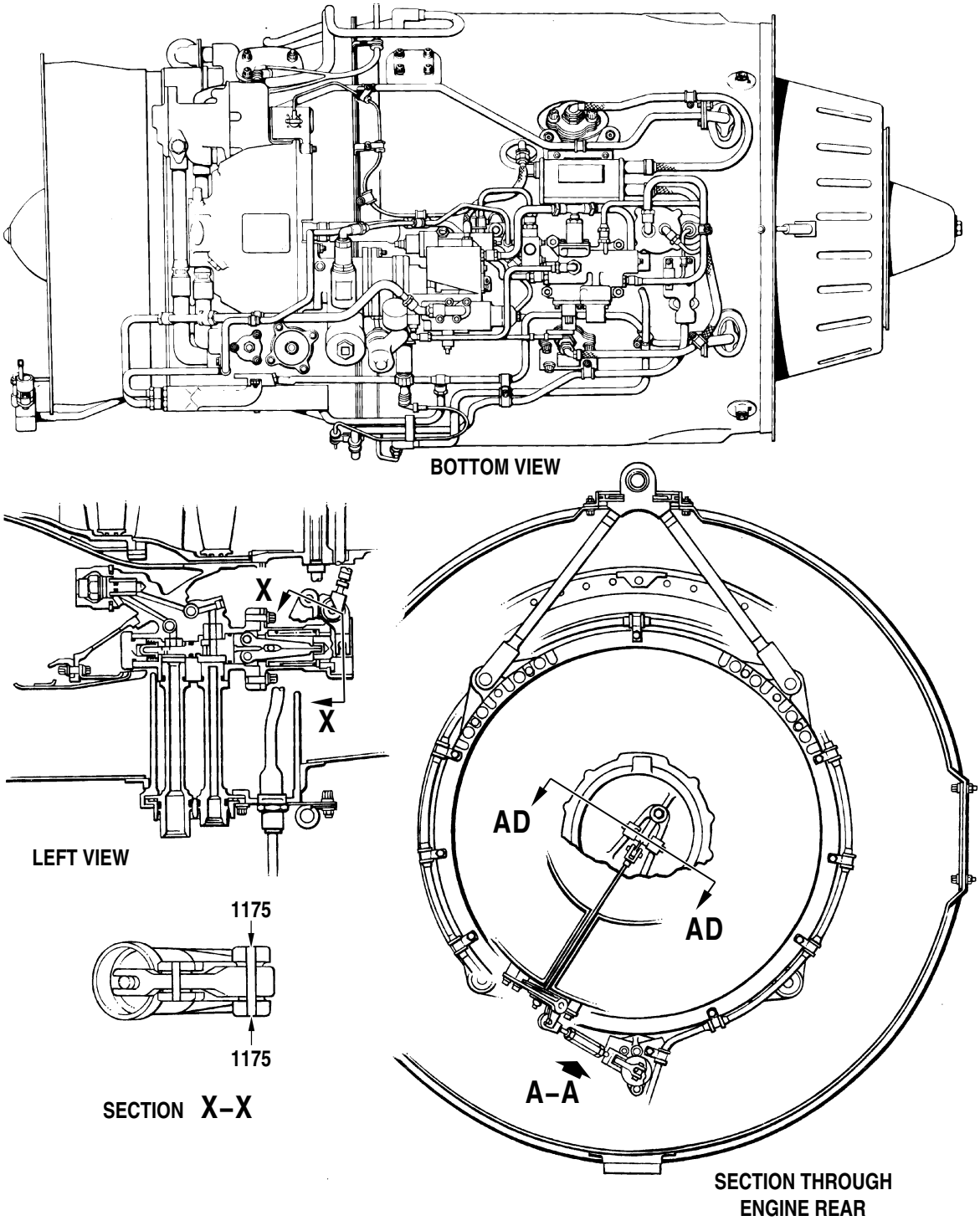

JT15D-5 Shown, JT15D-5R Similar

C11543B

Fits, Clearances and Torque Loadings
Figure 209 (Sheet 2)

P&WC Proprietary Information. Subject to the restriction on the title page.
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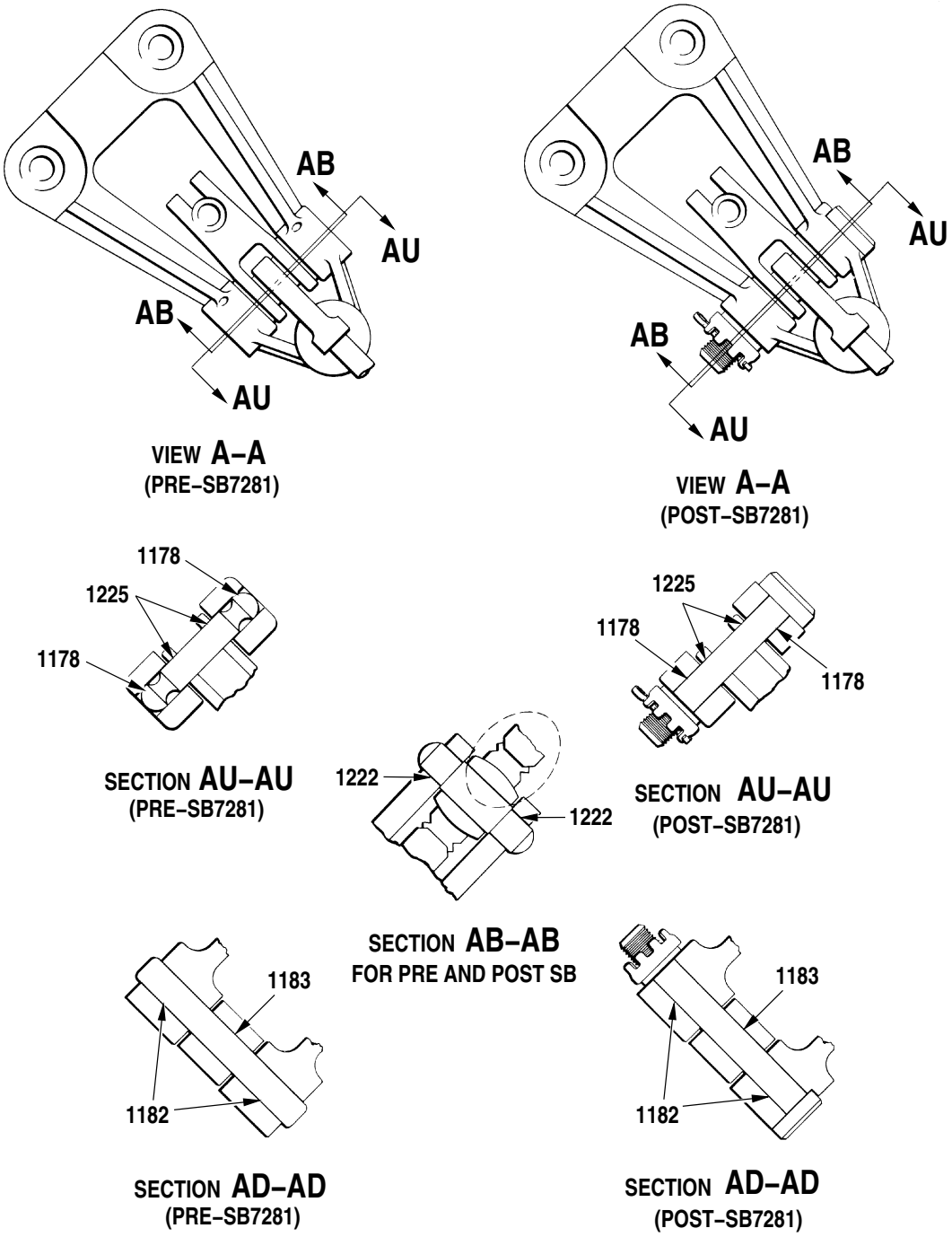

JT15D-5 (Pre-SB7384) C19223B

Fits, Clearances and Torque Loadings
Figure 209 (Sheet 3)

P&WC Proprietary Information. Subject to the restriction on the title page.
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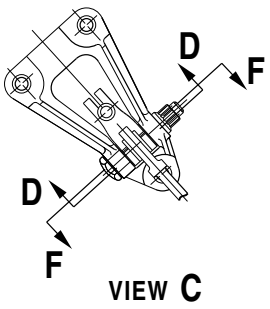
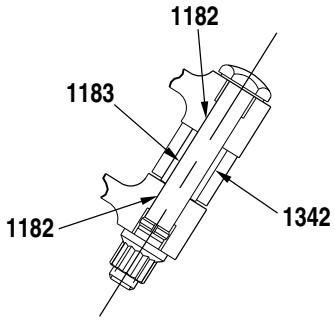
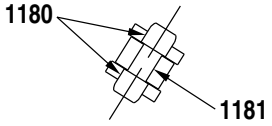


VIEW C



SECTION A–A



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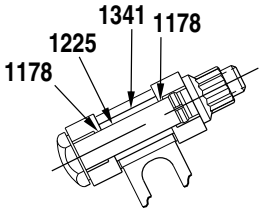

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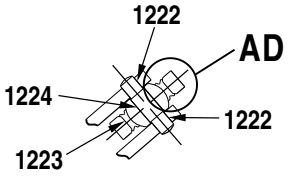

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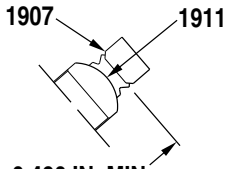

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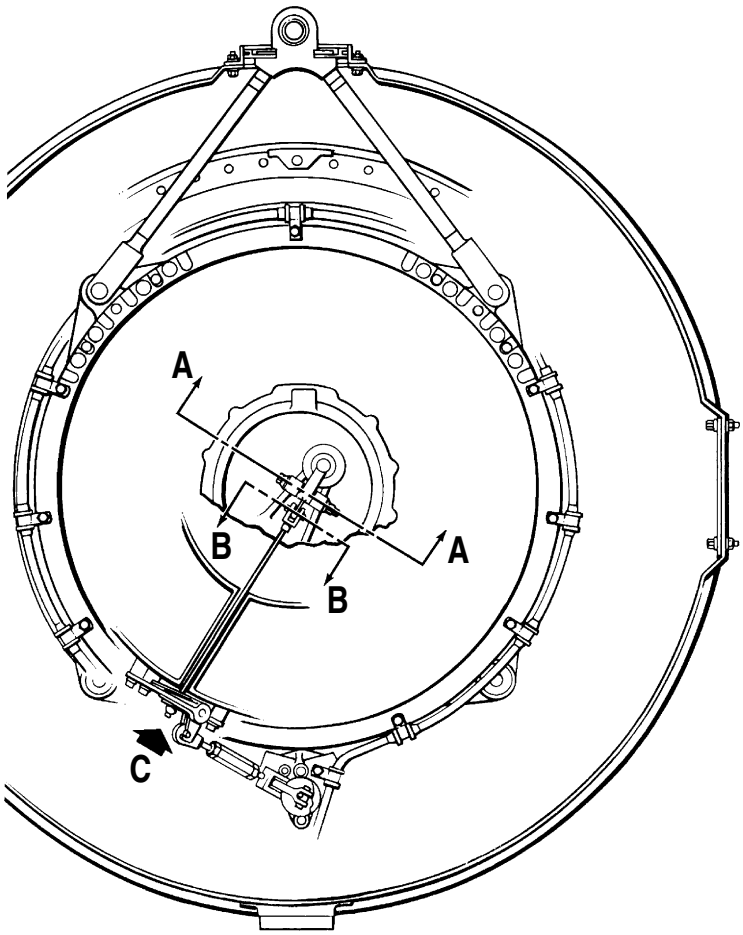

JT15D-5 (Post-SB7384) and JT15D-5R

C34489B

Fits, Clearances and Torque Loadings
Figure 209 (Sheet 4)

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LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
LEP	1	Apr 04/2016
	2 blank	Apr 04/2016
Contents	1	Apr 04/2016
	2	Apr 04/2016
72-60-00 Description and Operation	1	Oct 22/99
	2	Oct 22/99
72-60-01 Description and Operation	1	Oct 22/99
	2 blank	Oct 22/99
72-60-01 Maintenance Practices	201	Oct 06/2006
	202	Oct 06/2006
	203	Oct 06/2006
	204	Oct 06/2006
	205	Oct 06/2006
	206	Oct 06/2006
	207	Oct 06/2006
	208	Oct 06/2006
	209	Oct 06/2006
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	211	Oct 06/2006
	212 blank	Oct 06/2006
72-60-02 Description and Operation	1	Oct 22/99
	2	Oct 22/99
	3	Oct 22/99
	4 blank	Oct 22/99
72-60-02 Maintenance Practices	201	Apr 04/2016
	202	Apr 04/2016
	203	Apr 04/2016
	204	Apr 04/2016
	205	Apr 04/2016
	206	Apr 04/2016
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The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
ACCESSORY DRIVES - DESCRIPTION AND OPERATION	**72-60-00**
1. Engine Accessory Drives)	1
ACCESSORY GEARBOX AND DRIVESHAFT - DESCRIPTION AND OPERATION	**72-60-01**
1. Accessory Gearbox Assembly and Driveshaft	1
A. Description	1
ACCESSORY GEARBOX AND DRIVESHAFT - MAINTENANCE PRACTICES	**72-60-01**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal of Accessory Gearbox (AGB)	201
B. Removal of Engine Identification and Trim Plates	207
C. Installation of Engine Identification and Trim Plates on Replacement AGB	207
D. Installation of Accessory Gearbox (AGB)	207
6. Inspection/Check	210
A. Procedure	210
7. Fits, Clearances and Torque Loadings	210
AGB EXTERNALS AND OIL PUMP - DESCRIPTION AND OPERATION	**72-60-02**
1. Description)	1
AGB EXTERNALS AND OIL PUMP- MAINTENANCE PRACTICES	**72-60-02**
1. General	201
2. Consumable Materials	201
3. Special Tools	201

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The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
AGB EXTERNALS AND OIL PUMP- MAINTENANCE PRACTICES (Cont'd)	**72-60-02**
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal of Oil Pump	201
B. Installation of Oil Pump	205
C. Removal of Accessory Drive Seals	206
D. Installation of Accessory Drive Seals	207
E. Removal of Centrifugal Breather Gearshaft Carbon-Face Seal	209
F. Installation of Centrifugal Breather Gearshaft Carbon-Face Seal	209
G. Removal of Starter-Generator	211
6. Cleaning/Painting	211
A. Oil Pump Inlet Strainer Sleeve	211
7. Approved Repairs	211
A. Oil Pump - Repair by Replacement	211
B. Repair of Corrosion - Accessory Gearbox Housing	212
8. Fits, Clearances and Torque Loadings	213

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The export control classification with respect to this document is contained on the back of the title page.

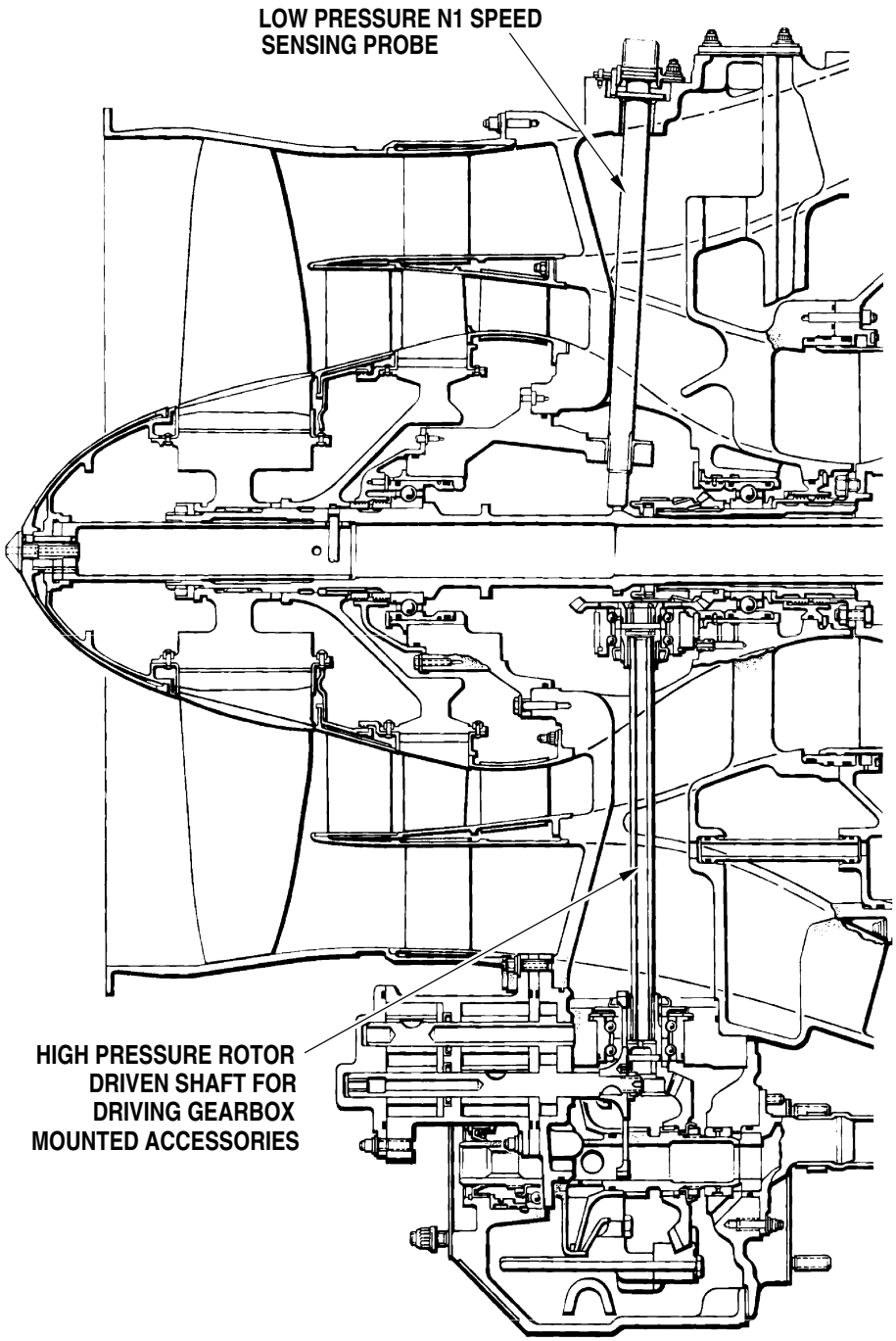
ACCESSORY DRIVES - DESCRIPTION AND OPERATION

1. Engine Accessory Drives (Ref. Fig. 1)

All engine-driven accessories except the N1 (LP compressor) speed sensor are mounted on the accessory gearbox, secured to the bottom of intermediate case.

Gearbox-mounted accessories are driven by a vertical driveshaft geared to the HP compressor rotor. The drive shaft passes through a strut at the 6 o'clock position on the intermediate case and is splined at both ends to engage bevel gears. The upper bevel gear meshes with the bevel gear on the HP compressor rotor shaft and the lower bevel gear meshes with the bevel gear on the starter-generator driveshaft in the accessory gearbox.

The N1 speed sensor is described in Chapter 73-20-05.



C11448

Engine Accessory Drives
Figure 1

ACCESSORY GEARBOX AND DRIVESHAFT - DESCRIPTION AND OPERATION

1. Accessory Gearbox Assembly and Driveshaft

A. Description

The accessory gearbox (Ref. 72-60-01) is mounted below the engine on the intermediate case , and is driven through a vertical tower shaft passing through the intermediate case 6 o'clock strut. The tower shaft splines engage bevel gears at both its ends. The upper gear meshes with the bevel gear on the HP compressor rotor shaft, and the lower gear meshes with and drives the bevel gear on the AGB starter-generator driveshaft. Two N2 speed sensor units, located in the accessory gearbox case (LH side), generate electrical pulses when the teeth of the oil pump drive gear pass closely to the sensor pole pieces.

ACCESSORY GEARBOX AND DRIVESHAFT - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the accessory gearbox and driveshaft.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC06-004	Anti-seize Compound

3. Special Tools

   The special tools listed below are used in the following procedures.

Tool No.	Name
PWC31013	Puller

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal of Accessory Gearbox (AGB) (Ref. Fig. 201)

      (1) Drain oil from engine (Ref. 79-00-01, OIL SYSTEM - SERVICING).

      (2) Remove all airframe accessories and lines from gearbox and oil filter housing assembly (Ref. Airframe Maintenance Manual).

      (3) Remove lockwire and two bolts (14) securing ground wire terminal to accessory gearbox (10). Remove ground wire terminals.

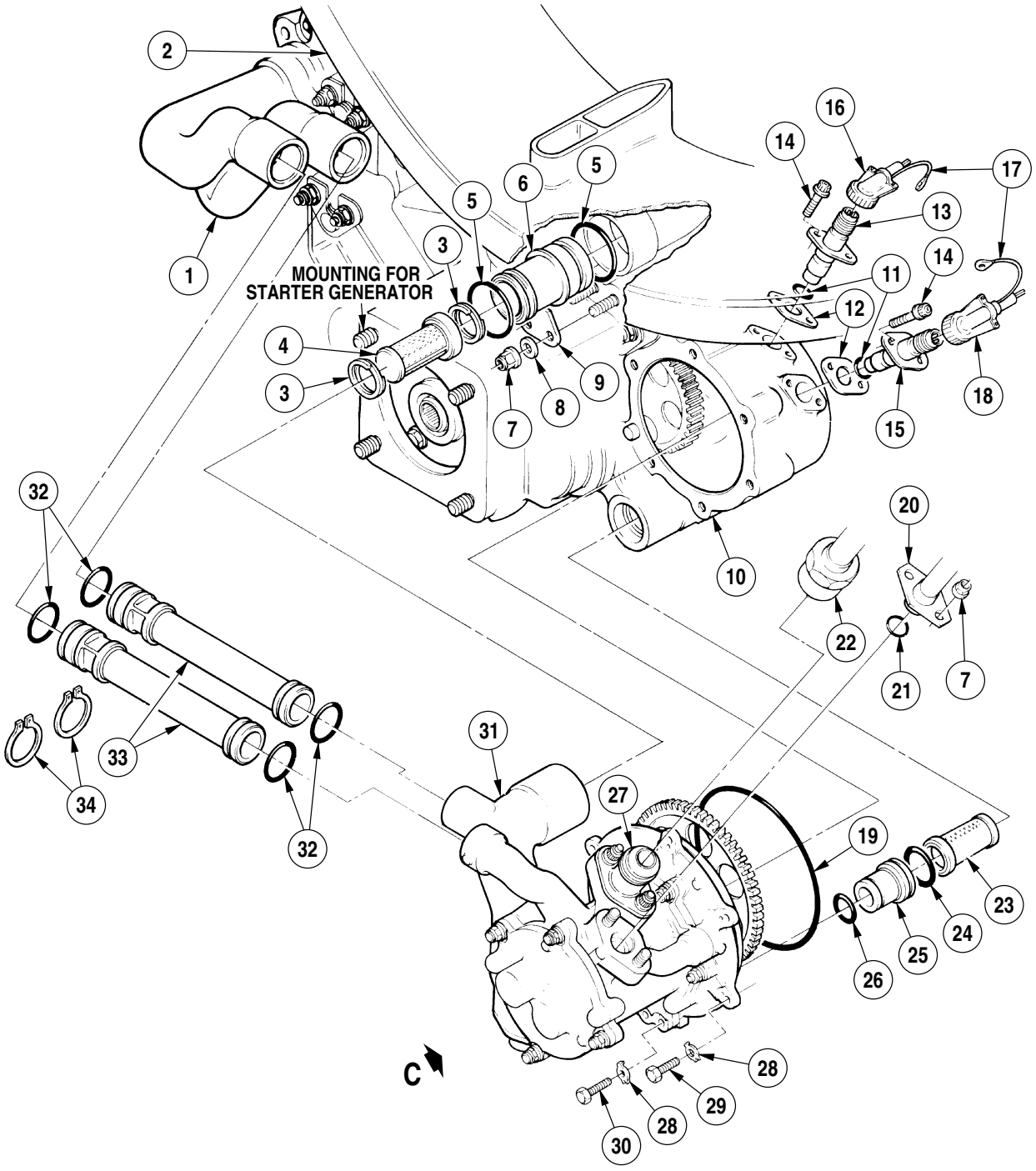
      (4) Disconnect wiring harness N2 speed sensor electrical connectors (16, 18) and suitably protect and support.

      (5) Remove remaining two bolts (14) securing N2 speed sensors (13, 15), preformed packings (11) and adjusting plates (12) to AGB (10). Remove and discard preformed packings.

         NOTE: Adjusting plates must remain with their respective N2 sensors as sets and should be reinstalled at original mounting boss on AGB.

      (6) For JT15D-5 (Pre-SB7280) engines, remove two self-locking nuts (53), bolts (51) and loop clamps (52). Remove AGB breather hose (54).

      (7) Remove two self-locking nuts (56) and EEC interrogation connector and bracket assembly (55).

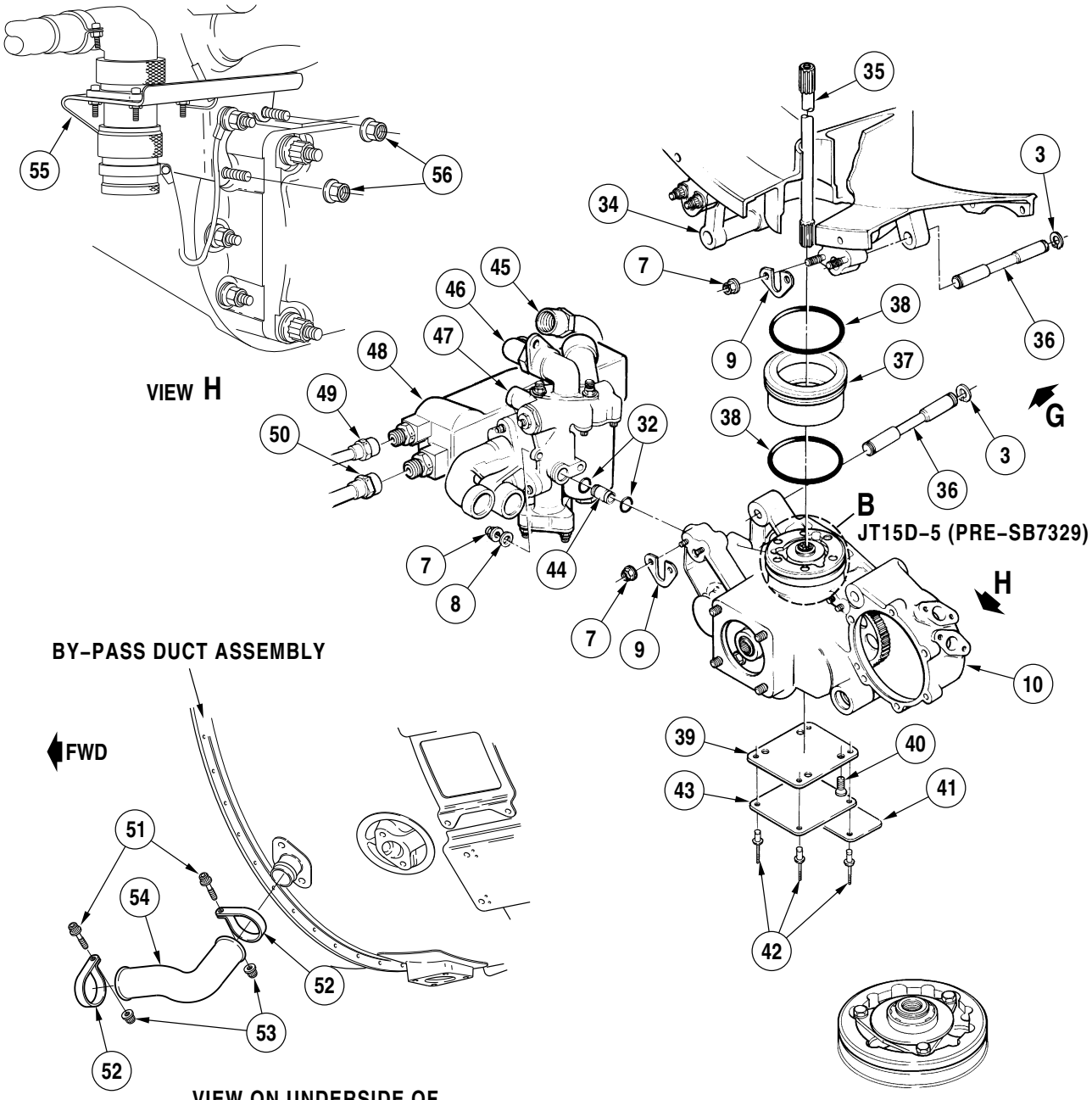


JT15D-5 SHOWN (JT15D-5R SIMILAR) C21606

Removal/Installation - Accessory Gearbox
Figure 201 (Sheet 1 of 3)

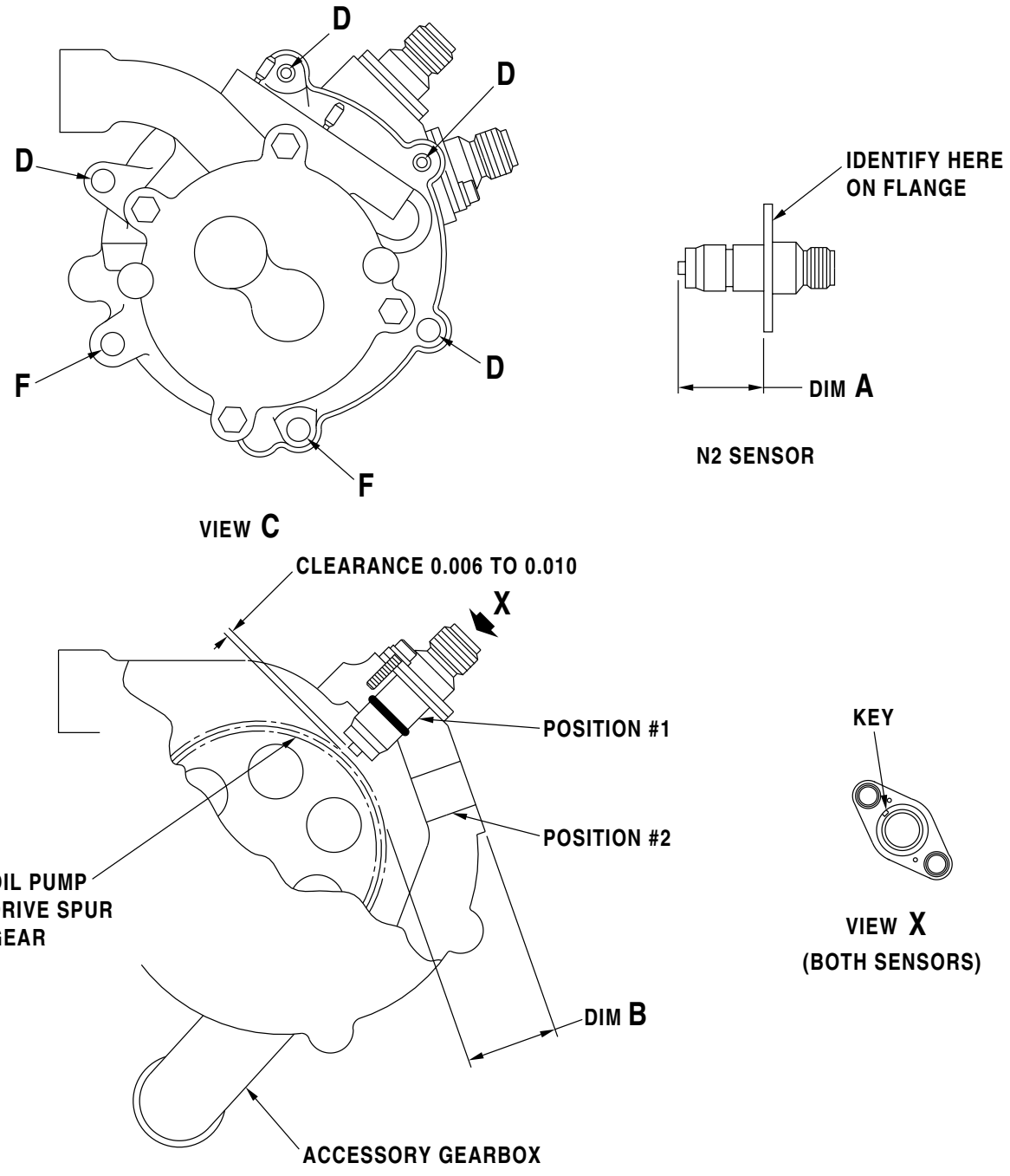
Key to Figure 201

1. Coupling
2. Intermediate Case
3. Retaining Ring
4. Strainer Element
5. Preformed Packing
6. Transfer Tube
7. Self-locking Nut
8. Washer
9. Retaining Plate
10. Accessory Gearbox
11. Preformed Packing
12. Adjusting Plate
13. N2 Speed Sensor
14. Bolt
15. N2 Speed Sensor
16. Wiring Harness N2 Speed Sensor Electrical Connector
17. Ground Cable Terminal
18. Wiring Harness N2 Speed Sensor Electrical Connector
19. Preformed Packing
20. No.4 Bearing Scavenge Oil Tube
21. Preformed Packing
22. Oil Tank-to-Pump Tube
23. Oil Strainer
24. Preformed Packing
25. Transfer Tube
26. Preformed Packing
27. Adapter
28. Keywasher
29. Bolt
30. Bolt
31. Oil Pump
32. Preformed Packing
33. Transfer Tube
34. Strut
35. Driveshaft
36. Headless Pin
37. Adapter
38. Preformed Packing
39. Retaining Plate
40. Screw
41. Trim Speed Instruction Plate
42. Rivet
43. Engine Identification Plate
44. Transfer Tube
45. Nos. 1,2,3 and 4 Bearings Pressure Oil Tube
46. Elbow
47. Oil Filter Housing Assembly
48. Oil Cooler
49. Pressure Fuel Tube
50. Pressure Fuel Tube
51. Bolt
52. Loop Clamp
53. Self-locking Nut
54. AGB Breather Hose
55. EEC Interrogation Connector and Bracket Assembly
56. Self-locking Nut



JT15D-5 SHOWN (JT15D-5R SIMILAR) C11395D

Removal/Installation - Accessory Gearbox
Figure 201 (Sheet 2)



C32864

Removal/Installation - Accessory Gearbox
Figure 201 (Sheet 3)

(8) Remove fuel pump, bleed valve actuator and HMU from accessory gearbox (Ref. 73-20-02).

(9) Remove two self-locking nuts (7) securing No. 4 bearing scavenge oil tube (22) to boss on oil pump (31). Remove and discard preformed packing (21) from end of tube.

(10) Remove lockwire and disconnect coupling nut on oil-to-tank tank tube (22) from adapter (27) on oil pump (31).

(11) Remove two retaining rings (3) securing transfer tubes (33) in oil filter tubes coupling (1). Push tubes into coupling to provide clearance for removal of oil pump.

(12) Remove six bolts (29, 30) and keywashers (28) securing oil pump (31) to AGB (10). Remove pump with preformed packing (19). Remove and discard packing.

(13) Remove transfer tube (25) and oil strainer element (23) with two preformed packings (24, 26). Discard packings.

(14) For the JT15D-5R, remove the oil filter housing (48) (Ref. 79-21-01, MAINTENANCE PRACTICES).

(15) For the JT15D-5, remove the oil filter housing (48) as follows:

(a) Remove lockwire and disconnect pressure fuel tubes (49, 50) at oil cooler (48) and pressure oil tube (45) from oil filter housing elbow (46).

(b) Remove four self-locking nuts (7) and washers (8) and remove oil filter housing assembly (47) with attached oil cooler (48), coupling (1) and transfer tubes (33) from AGB (10).

(c) Remove gearbox oil transfer tube (44) and two preformed packings (32). Discard packings.

(16) Remove two self-locking nuts (7) and two washers (8) securing retaining plate (9) to AGB (10). Remove retaining plate and remove transfer tube (6) assembly from intermediate case.

(17) Remove retaining rings (3) securing strainer element (4) in transfer tube (6) and remove strainer element. Remove and discard two preformed packings (5).

(18) Remove two retaining rings (3) securing headless pins (36) through AGB (10) at intermediate case (2) and lower end of gearbox strut (34).

NOTE: It is not necessary to disconnect gearbox strut from intermediate case.

(19) Remove four self-locking nuts (7) securing retaining plates (9) for headless pins (36) through AGB (10) . Support the gearbox to prevent it dropping, and remove pins together with locking plates, using puller (PWC31013).

(20) Lower AGB (10) from intermediate case (2), keeping driveshaft (35) in gearbox.

(21) Remove adapter (37) from AGB (10). Remove two preformed packings (38) from adapter (37) and AGB. Discard packings.

NOTE: If existing AGB is to be replaced, the engine identification and trim plates must be removed from the existing gearbox housing and installed on replacement gearbox housing (Ref. Subparas. B. and C. following).

B. Removal of Engine Identification and Trim Plates (Ref. Fig. 201)

(1) Remove head from four rivets (42) using a 0.125 inch drill.

(2) Using a suitable punch, lightly tap rivet stem through trim plate (41) and identification plate (43) until plates are free.

(3) Remove four screws (40) and retaining plate (39).

(4) Remove wasted portion of rivets from cavities in accessory gearbox housing.

C. Installation of Engine Identification and Trim Plates on Replacement AGB (Ref. Fig. 201)

(1) Secure retaining plate (39) to AGB (10) with four screws (40). Torque screws 9 to 11 lb.in.

(2) Install identification plate (43) on retaining plate (39) with trade mark to engine forward and secure with two blind rivets (42) at the top corners.

(3) Install trim plate (41) over bottom portion of identification plate (43) ensuring no information is obscured. Secure with two blind rivets (42).

D. Installation of Accessory Gearbox (AGB) (Ref. Fig. 201)

CAUTION: N2 SPEED SENSOR SPACER THICKNESS MUST BE CORRECTLY CALCULATED IF REPLACEMENT ACCESSORY GEARBOX, OIL PUMP, SENSOR OR SPACER IS INSTALLED.

(1) Install one preformed packing (38) on adapter (37) and one preformed packing (38) on AGB (10). Ensure splines of driveshaft (35) are correctly engaged in gearbox bevel gear internal spline.

(2) Smear anti-seize compound (PWC06-004) on two headless pins (36). Engage retaining plates (9) in groove of headless pins and install adapter (37) in intermediate case.

(3) Raise AGB (10) into position. Ensure splines at top end of driveshaft (1) are engaged with gear in engine. Rotate gearbox gear-train using exposed oil pump drive gear to ensure full engagement. Insert headless pins (36) together with retaining plates (9).

(4) Install one retaining ring (3) on each headless pin (36) at rear of AGB (10). Secure retaining plates (9) with two self-locking nuts (7). Tighten nuts and torque 32 to 36 lb.in.

(5) Install strainer element (4) in transfer tube (6) and secure with retaining rings (3). Install new preformed packings (5) on transfer tube (6) and install tube assembly in intermediate case oil tank outlet.

(6) Position transfer tube (6) so anti-rotation flat abuts boss on intermediate case (2). Secure tube assembly with retaining plate (9) using two washers (8) and two self-locking nuts (7). Tighten nuts and torque 32 to 36 lb.in.

(7) For the JT15D-5R, install the oil filter housing (38) (Ref. 79-21-01, MAINTENANCE PRACTICES).

(8) For the JT15D-5, install the oil filter housing (48) as follows:

(a) Install two new preformed packings (32) on gearbox oil transfer tube (44) and position in gearbox orifice.

(b) Mount oil filter housing assembly (47) with oil cooler (48) on the four studs protruding from the AGB (10). Secure using four washers (8) and four self-locking nuts (7). Tighten nuts and torque 32 to 36 lb.in.

(c) Install pressure fuel tubes (49, 50) at respective connectors on oil cooler (48). Tighten coupling nut on tube (50) 270 to 300 lb.in. and lockwire. Tighten coupling nut on tube (49) 340 to 370 lb.in. and lockwire.

(9) Insert strainer element sleeve (23) into AGB scavenge outlet. Install new preformed packings (24, 26) on transfer tube (25) and install tube assembly in AGB scavenge outlet.

(10) Install new preformed packing (19) on oil pump (31). Align locating hole in pump flange with dowel on pump mounting pad on AGB. Install pump, carefully meshing gears to avoid damaging gear teeth. Install two bolts (30) and keywashers (28) at locations F (Ref. View C) with four bolts (29) and keywashers (28) at locations D. Tighten, but do not torque bolts at this stage.

(11) Install two new preformed packings (32) on each transfer tube (33) and push transfer tubes into ports on oil pump (31). Secure tubes with retaining rings (3) at coupling (1) end.

(12) Torque bolts (29, 30) securing oil pump (31) to AGB (10) 24 to 36 lb.in. and lock keywashers.

(13) Install new preformed packing (21) on No. 4 bearing scavenge oil tube (20). Secure tube to boss on oil pump (31) with two nuts (7). Torque nuts 32 to 36 lb.in.

(14) Secure oil tube (22) coupling nut to adapter (27) on oil pump (31). Torque tube coupling nut 650 to 700 lb.in. and lockwire.

(15) Install fuel pump, bleed valve actuator and HMU (Ref. 73-20-02).

(16) JT15D-5 (Pre-SB7280) engines: install AGB breather hose (54) between breather adapter on AGB and bypass duct connector. Secure with two loop clamps (52), bolts (51), and self-locking nuts (53). Torque nuts 32 to 36 lb.in.

(17) Secure EEC interrogation connector and bracket assembly (55) to AGB with two self-locking nuts (56). Torque nuts 32 to 36 lb. in.

CAUTION: HANDLE SENSORS CAREFULLY TO AVOID DAMAGE TO PROBE TIPS.

(18) Establish correct clearances between N2 speed sensors and oil pump drive spur gear as follows :

(a) Measure dimension A on uninstalled N2 speed sensor (13) or (15). Record dimension. If replacement speed sensor is to be installed, etch position characters #1 or #2 as appropriate onto upper or lower speed sensor flange.

(b) Measure dimension B, from outer face of boss on AGB housing to oil pump drive spur gear. Rotate gear 360 degrees and note point with smallest clearance. Record smallest reading as Dimension B.

(c) Calculate thickness of adjusting plate required to give correct clearance using formula:

1 (Dimension A + 0.008 inch - Dimension B) = target adjusting plate thickness ± 0.002 inch

2 Measure actual adjusting plate thickness and compare to target thickness value. If required, grind adjusting spacer to obtain target thickness.

(d) Electrolytic etch thickness dimension and character #1 on ground face of adjusting plate (12) for upper N2 speed sensor (13). Etch thickness dimension and character #2 on adjusting plate (12) for lower speed sensor (15). Depth of etching must not exceed 0.002 inch. Keep N2 sensor and matching adjusting plate as a set.

(e) Repeat steps (a) through (d) for remaining N2 speed sensor.

(19) Install new preformed packing (11) on N2 speed sensors (13) and (15).

CAUTION: SPEED SENSORS AND ADJUSTING PLATES MUST BE INSTALLED AT THEIR ORIGINAL LOCATIONS. DO NOT MIX SPEED SENSORS AND ADJUSTING PLATES.

(20) Install adjusting plates (12) of correct dimension onto matching speed sensors (13) and (15). Install speed sensor (13) with adjusting plate at upper position #1 on AGB housing. Install speed sensor (15) with adjusting plate at lower position #2. Check that sensors are installed with key to correct side (Ref. View X).

(21) Secure N2 speed sensor (13) and (15), with adjusting plates (12) and ground cables (17) with four bolts (14). Torque bolts 24 to 36 lb.in. and lockwire.

(22) Install engine wiring harness electrical connectors (16), and (18) onto receptacles on N2 speed sensors (13) and (15). Tighten connector handtight plus 45 degrees and lockwire.

(23) Install airframe accessories and connect lines to gearbox and oil pressure relief valve (Ref. Airframe Maintenance Manual).

(24) Replenish oil system (Ref. 79-00-01, OIL SYSTEM - SERVICING)

6. Inspection/Check

A. Procedure

(1) After removal of two headless pins (35, Fig. 201), or three headless pins with accessory gearbox (10) and strut (2), visually inspect for evidence of wear due to fretting and check components as necessary.

(a) If pin(s) (4) exhibit wear in excess of 0.005 inch (Ref. 0.368 inch dia. minimum) reject and install new pin(s) (Ref. Illustrated Parts Catalog P/N 3033444).

(b) If bore(s) of strut (2) exhibit wear in excess of 0.005 inch (Ref. 0.380 inch dia. maximum) reject and install new strut (Ref. Illustrated Parts Catalog P/N 3033444).

(c) If bore(s) in sleeve(s) in AGB (10) exhibit wear in excess of 0.005 inch (Ref. 0.380 inch dia. maximum) return gearbox to an approved overhaul facility for repair in accordance with overhaul manual instructions.

7. Fits, Clearances and Torque Loadings

TABLE 201, Fits and Clearances

REF. NO.	Name	Dim. for Ref. inches (mm) Min.	Dim. for Ref. inches (mm) Max.	Limits inches (mm) Min.	Limits inches (mm) Max.	Limits inches (mm) Replace
Not Applicable						

TABLE 202, Torque and Stretch

REF. NO.	Name	Limits Min.	Limits Max.
Not Applicable			

TABLE 203, Spring Pressure

REF. NO.	Name	Limits Min.	Limits Max.
Not Applicable			

TABLE 204, Special Assembly

REF. NO.	Name	Limits Min.	Limits Max.
Not Applicable			

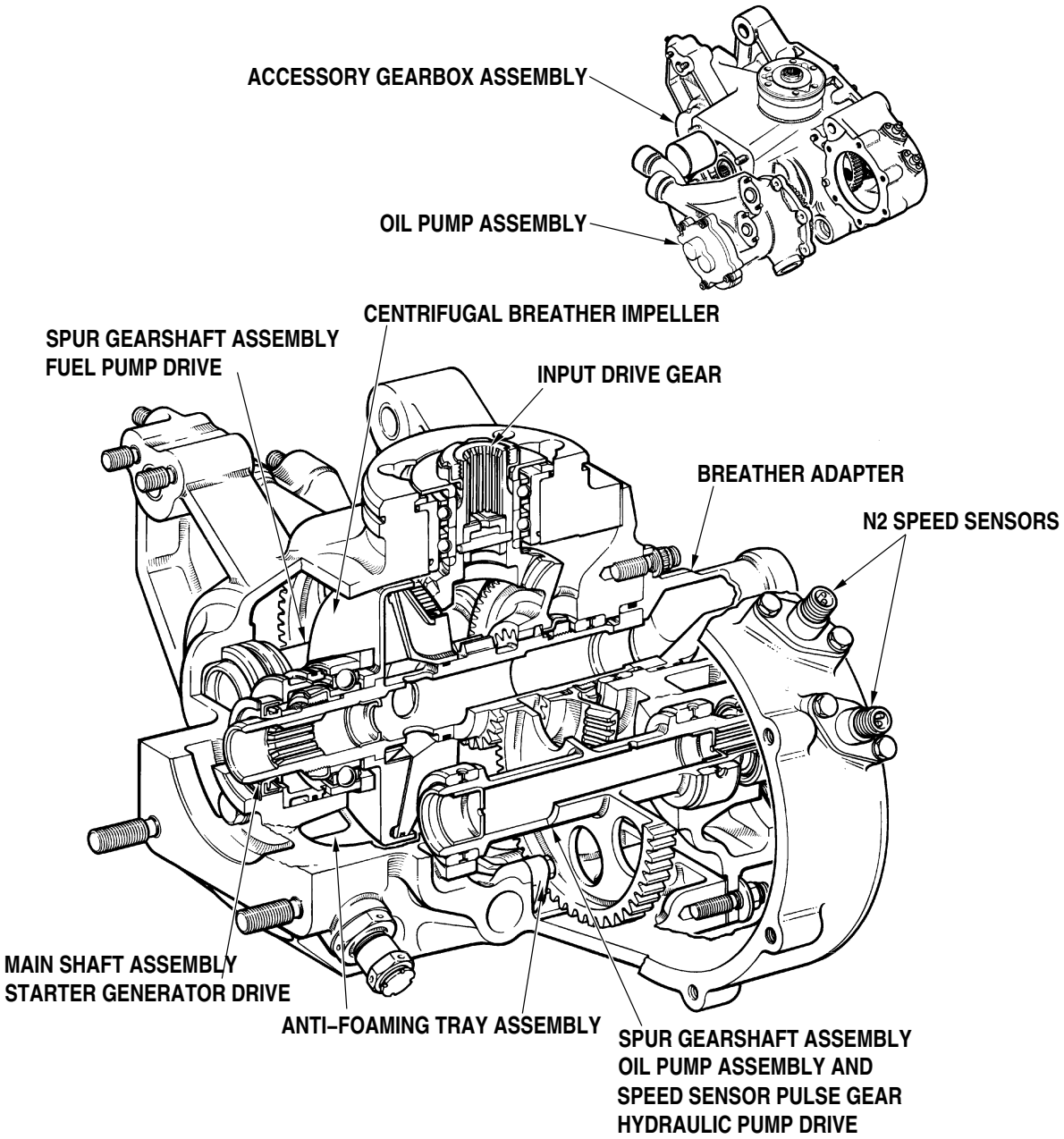
AGB EXTERNALS AND OIL PUMP - DESCRIPTION AND OPERATION

1. Description (Ref. Fig. 1)

The accessory gearbox consists of a cast magnesium housing with a rear cover. An accessory starter-generator mounts on the starter-generator pad of the housing, to provide and receive drive by means of a spline coupling to the gearbox main shaft assembly. The main shaft assembly is supported by a thrust bearing at the front of the housing and a plain bearing in the gearbox cover at the rear. The main shaft, which incorporates a centrifugal impeller for oil-air separation, has an integral spur gear which drives two identical gears supported by identical plain bearings in the housing and cover. An oil containment carbon face seal is mounted at rear end of the main shaft, while the front end of the shaft has a garter seal and retaining ring. Oil trays installed in the housing bottom reduce foaming. The fuel pump mounts on a pad located on the right of the gearbox cover. The left-hand pad is spare and provides for the mounting of an airframe accessory e.g., hydraulic pump.

The fuel drive and spare pump drives have identical garter seals and spiral retaining rings at the rear. The spare pump gear drives a spur gear, which in turn drives the oil (pressure and scavenge) pump assembly mounted on the left-hand side of the housing. The oil pump assembly driven spur gear is also the pulse generator gear supplying high pressure rotor speed signals to two speed sensors radially located in the left-hand side of the accessory gearbox casing. A pad (normally blanked off) at the front of the oil pump assembly, provides for installation of a test high pressure (N2) compressor rotor tachometer.

Pressure oil for the lubrication of the AGB bearings is routed via a transfer tube from the oil filter, and passes through integral passageways in the housing and cover. An engine data plate is riveted onto the engine identification plate installed at the underside of the accessory gearbox housing.



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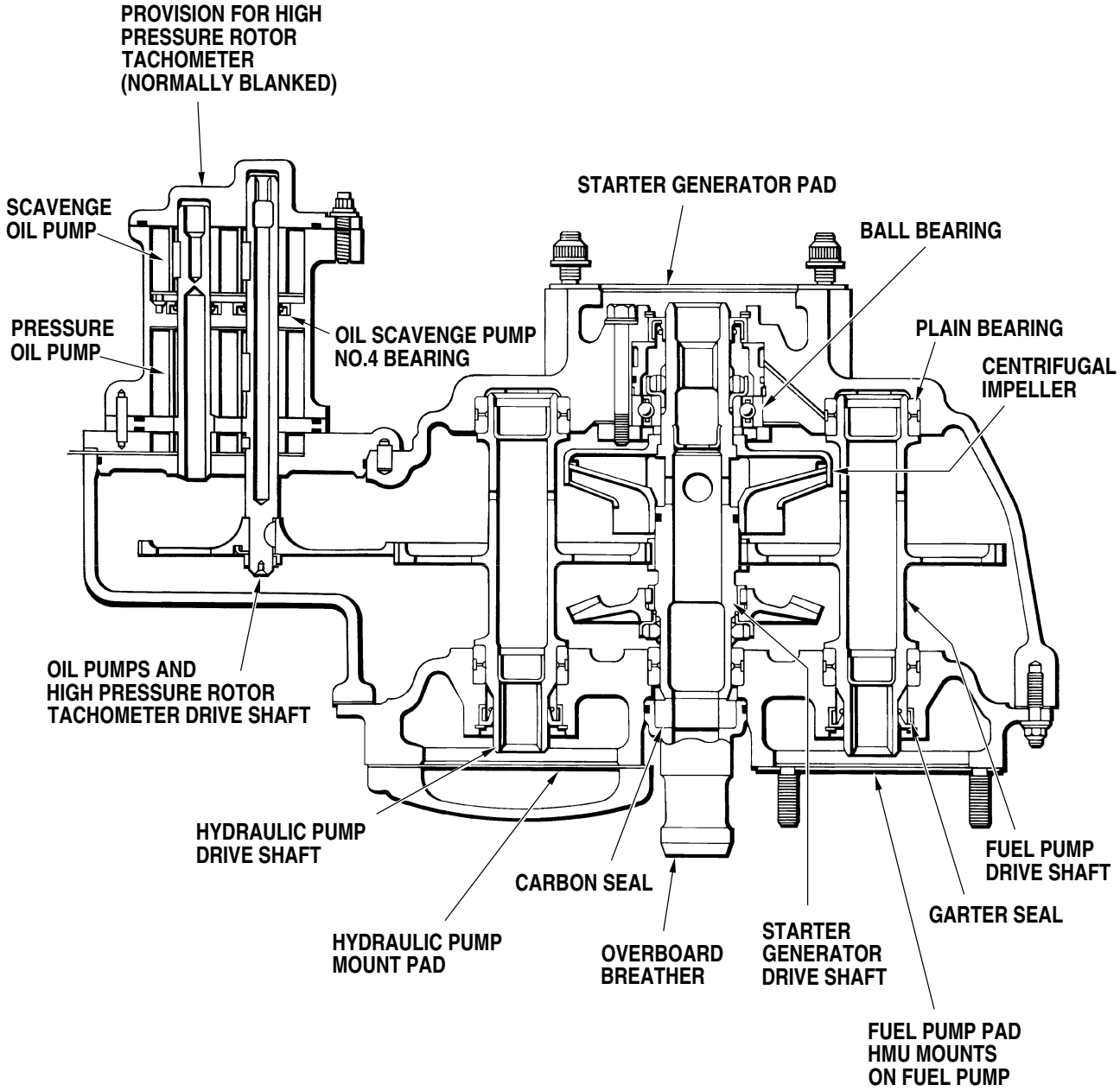
Accessory Gearbox Cutaway and Cross Section
Figure 1 (Sheet 1 of 2)



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Accessory Gearbox Cutaway and Cross Section
Figure 1 (Sheet 2)

AGB EXTERNALS AND OIL PUMP- MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the oil pump, AGB oil seals and the starter generator, installed on the accessory gearbox.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Engine Lubricating Oil
PWC05-037	Enamel, Aluminized
PWC05-061	Cloth, Coated Abrasive
PWC05-101	Cloth, Abrasive
PWC11-014	Alcohol, Isopropyl
PWC11-027	Petroleum Solvent
PWC13-001	Primer, Epoxy

3. Special Tools

   The special tools listed below are used in the following procedures.

Tool No.	Name
PWC31061	Puller
PWC31062	Drift
PWC31092	Drift, Seal, Starter-Generator Mount Pad
PWC31063	Support
PWC31382-01	Extractor
PWC31382-02	Extractor
PWC66810	Drift, Seal, Fuel Control and Spare Accessory Drive Mount Pads

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal of Oil Pump (Ref. Fig. 201)

      (1) Drain oil from engine (Ref. 79-00-01, OIL SYSTEM - SERVICING).

      (2) Remove two retaining rings (34) securing transfer tubes (33) in coupling (1). Push tubes into coupling to provide clearance for removal of oil pump.

      (3) Remove two self-locking nuts (7) securing No. 4 bearing scavenge oil tube assembly (19) to boss on oil pump (28). Remove tube assembly from pump boss and remove preformed packing (20). Discard preformed packing.

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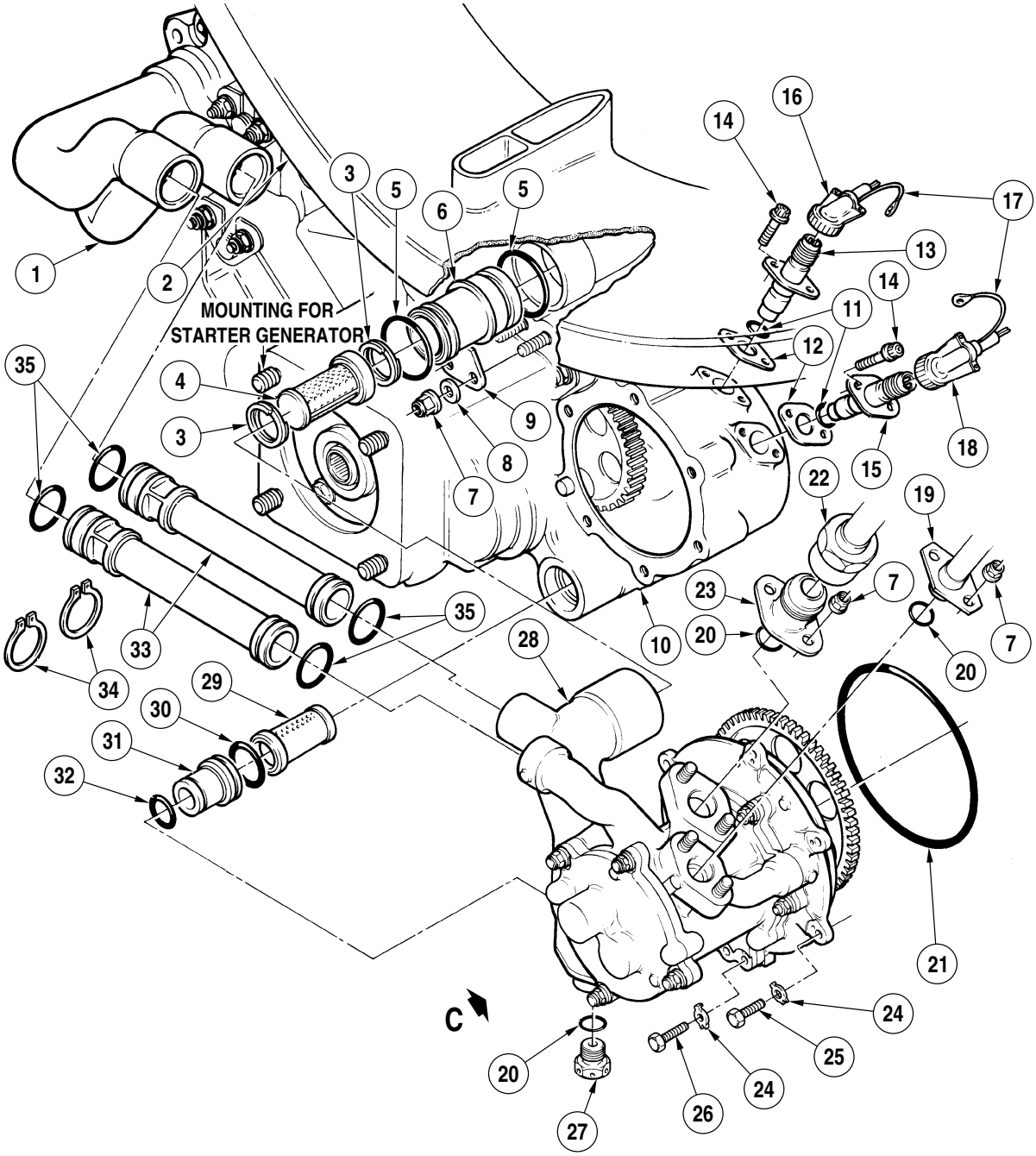

JT15D-5 SHOWN (JT15D-5R SIMILAR) C19997B

Removal/Installation - Oil Pump
Figure 201 (Sheet 1 of 2)

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Key to Figure 201

1. Coupling
2. Intermediate Case
3. Retaining Ring
4. Strainer Element
5. Preformed Packing
6. Transfer Tube
7. Self-locking Nut
8. Washer
9. Retaining Plate
10. Accessory Gearbox
11. Preformed Packing
12. Adjusting Plate
13. N2 Speed Sensor
14. Bolt
15. N2 Speed Sensor
16. Wiring Harness N2 Speed Sensor Electrical Connector
17. Ground Cable Terminal
18. Wiring Harness N2 Speed Sensor Electrical Connector
19. No. 4 Bearing Scavenge Oil Tube
20. Preformed Packing
21. Preformed Packing
22. Oil-to-tank Tube
23. Adapter
24. Keywasher
25. Bolt
26. Bolt
27. Drain Plug
28. Oil Pump
29. Strainer Sleeve
30. Preformed Packing
31. Transfer Tube
32. Preformed Packing
33. Transfer Tube
34. Retaining Ring
35. Preformed Packing

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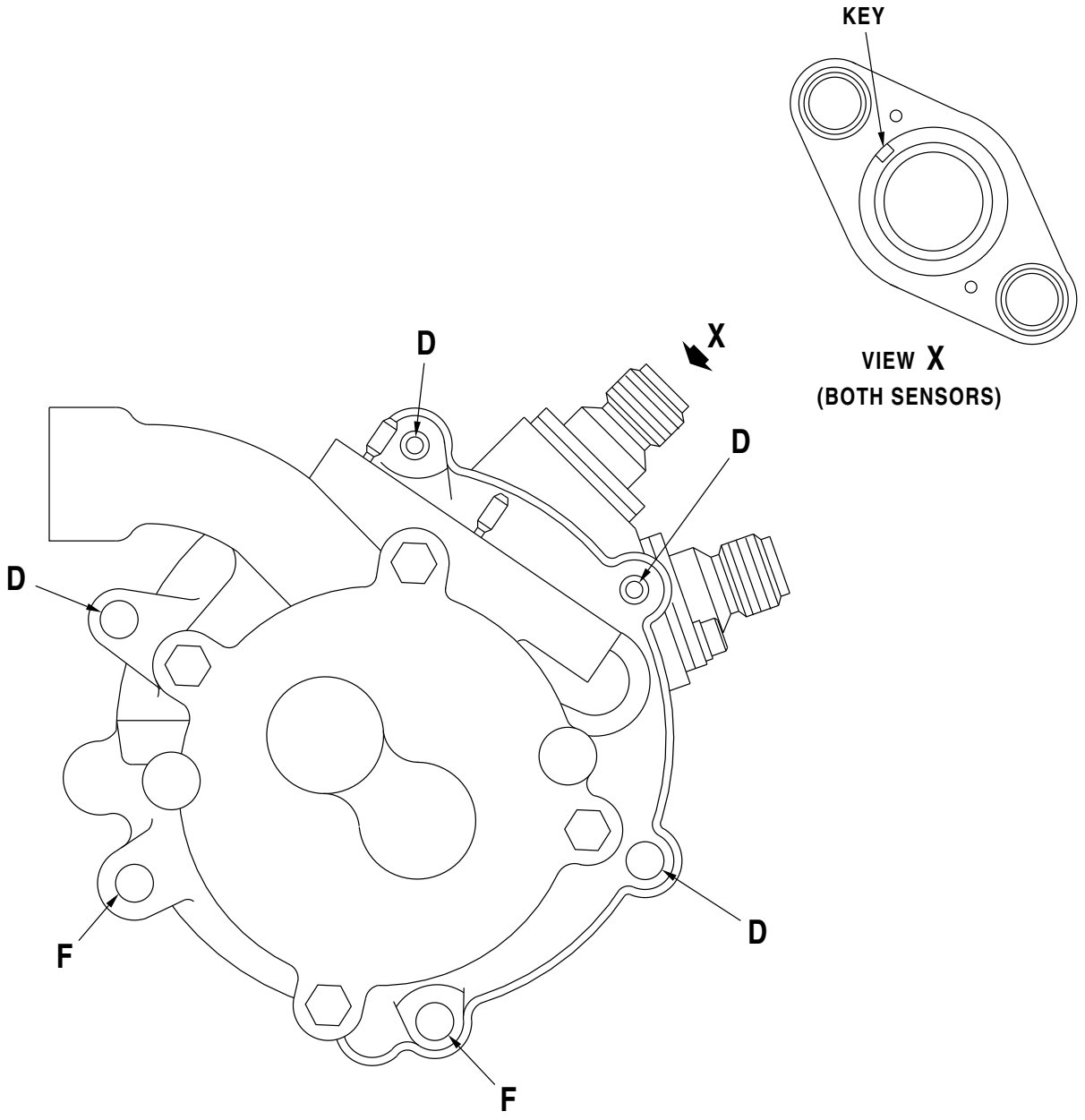

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Removal/Installation - Oil Pump
Figure 201 (Sheet 2)

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(4) Disconnect coupling nut on oil-to-tank tube (22). Remove two nuts (7) securing adapter (23) to oil pump (28). Remove adapter with preformed packing (20), and discard packing.

(5) Remove lockwire and disconnect two N2 speed sensor electrical connectors (16) and (18). Remove four bolts (14), two N2 speed sensors (13) and (15), adjusting plates (12) and terminals on ground cables (17). Remove and discard preformed packings (11).

NOTE: Spacers must remain with their respective N2 sensors as sets and should be reinstalled at original mounting boss on AGB.

(6) Unlock keywashers (24) and remove six bolts (25) and (26) with keywashers securing oil pump (28) to accessory gearbox (10). Remove pump with preformed packing (21). Remove and discard packing.

(7) Remove transfer tube (31) and strainer sleeve (29) with two preformed packings (30) and (32). Discard packings. Clean and inspect strainer sleeve (Ref. Para. 6.).

(8) Remove oil pump drain plug (27) with preformed packing (20). Discard packing.

(9) Remove two nuts (7), two washers (8) and retaining plate (9) from accessory gearbox (10). Remove transfer tube (6) with strainer (4) installed. Remove and discard two preformed packings (5). Remove two retaining rings (3) and strainer (4) from transfer tube.

(10) Remove two transfer tubes (33) with preformed packings (35). Remove and discard packings.

B. Installation of Oil Pump (Ref. Fig. 201)

(1) Insert strainer sleeve (29) into accessory gearbox (10) scavenge outlet. Install new preformed packings (30) and (32) on transfer tube (31) and install tube assembly in accessory gearbox scavenge outlet.

(2) Insert oil strainer (4) in transfer tube (6) and secure in place with two retaining rings (3). Install two new preformed packings (5) on transfer tube (6) and install tube assembly in accessory gearbox (10). Secure tube assembly with retaining plate (9), two washers (8) and two nuts (7).

(3) Install two new preformed packings (35) on each transfer tube (33) and push transfer tubes into ports on coupling (1). Secure tubes with retaining rings (34) at coupling end.

(4) Install new preformed packing (21) on oil pump (28). Align locating hole in pump flange with dowel on pump mounting pad on accessory gearbox and install pump, carefully meshing gears to avoid damaging gear teeth. Install two bolts (26) and keywashers (24) at locations F (Ref. View C) with four bolts (25) and keywashers (24) at locations D. Tighten, but do not torque bolts at this stage.

(5) Install a new packing (20) on the oil pump drain plug (27). Install the oil pump drain plug (27) in the oil pump (28). Torque the drain plug (27) 110 to 120 lb.in. and lockwire.

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(6) Install new preformed packing (20) on adapter (23) and secure adapter to the oil pump (28) with two nuts (7). Tighten and torque nuts 24 to 36 lb.in. Install tube (22) coupling nut on adapter. Tighten and torque coupling nut 650 to 700 lb.in. and lockwire.

(7) Install new preformed packing (20) on No. 4 bearing scavenge oil tube (19) and install onto oil pump (28) boss. Secure tubes with two self-locking nuts (7), tighten and torque to 32 to 36 lb.in.

(8) Torque bolts (25) and (26) securing oil pump (28) to accessory gearbox (10) 24 to 36 lb.in. and lock keywashers.

CAUTION: N2 SPEED SENSOR ADJUSTING PLATE THICKNESS MUST BE CORRECTLY CALCULATED IF REPLACEMENT ACCESSORY GEARBOX, OIL PUMP, SENSOR OR ADJUSTING PLATE IS INSTALLED.

(9) Establish correct clearances between N2 speed sensors and oil pump drive spur gear (Ref. 73-20-05, MAINTENANCE PRACTICES).

(10) Install new preformed packing (11) on N2 speed sensors (13) and (15).

CAUTION: SPEED SENSORS AND ADJUSTING PLATES MUST BE INSTALLED AT THEIR ORIGINAL LOCATIONS. DO NOT MIX SPEED SENSORS AND ADJUSTING PLATES.

(11) Install adjusting plates (12) of correct dimension onto matching speed sensors (13) and (15). Install speed sensor (13) with adjusting plate at upper position #1 on AGB housing. Install speed sensor (15) with adjusting plate at lower position #2. Check that sensors are installed with key to correct side (Ref. View X).

(12) Secure N2 speed sensors (13) and (15), with adjusting plates (12) and ground cables (17) with four bolts (14). Torque bolts 24 to 36 lb.in. and lockwire.

(13) Install engine wiring harness electrical connectors (16) and (18) onto receptacles on N2 speed sensors (13) and (15). Tighten connector handtight plus 45 degrees and lockwire.

(14) Fill engine oil system (Ref. 72-00-00, OIL SYSTEM: SERVICING - Filling Oil System).

C. Removal of Accessory Drive Seals (Ref. Fig. 202)

(1) Remove accessory drive seals from starter-generator pad, hydraulic pump mounting pad or fuel pump pad, as follows:

(a) Remove the components listed below from their mounting pads on the accessory gearbox:

- Hydraulic pump/starter generator (Ref. AMM).
- HMU (Ref. 73-20-02, HYDROMECHANICAL METERING UNIT - MAINTENANCE PRACTICES).
- Fuel pump (Ref. 73-10-02, FUEL PUMP - MAINTENANCE PRACTICES).

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- Bleed valve actuator (Ref. 73-10-12, BLEED VALVE ACTUATOR - MAINTENANCE PRACTICES).

(b) Remove retaining ring (1).

CAUTION: DO NOT USE SCREWDRIVERS OR METALLIC PICKS TO REMOVE SEAL: DAMAGE TO SHAFTS OR SEAL RECESSES MAY RESULT.

(c) Remove oil seal (2) on starter-generator mounting pad using extractor (PWC31382-01).

(d) Remove oil seal (2) on hydraulic pump mount pad or on fuel pump mounting pad using extractor (PWC31382-02).

D. Installation of Accessory Drive Seals (Ref. Fig. 202)

CAUTION: SEAL MATERIAL IS DELICATE. PUSH SEAL INTO BOSS USING FINGER PRESSURE ONLY.

(1) Install accessory drive seal (2) for the starter-generator mounting pad as follows:

(a) Lubricate the seal (2) with engine oil (PWC03-001).

(b) Use optional drift (PWC31092) or manually install the seal in the starter-generator mounting pad with plain side of seal facing out.

(c) Secure seal with retaining ring (1).

(2) Install the accessory drive seals (2) for the hydraulic pump mounting pad and fuel pump mounting pad as follows:

(a) Lubricate the seal (2) with engine oil (PWC03-001).

(b) Use optional drift (PWC66810) or manually install the seal in the hydraulic pump mounting pad and fuel pump mounting pad with plain side of seal facing out.

(c) Secure seal(s) with retaining ring (1).

(3) Install the components listed below on their mounting pads on the accessory gearbox:

- Hydraulic pump/starter generator (Ref. AMM).
- HMU (Ref. 73-20-02, HYDROMECHANICAL METERING UNIT - MAINTENANCE PRACTICES).
- Fuel pump (Ref. 73-10-02, FUEL PUMP - MAINTENANCE PRACTICES).
- Bleed valve actuator (Ref. 73-10-12, BLEED VALVE ACTUATOR - MAINTENANCE PRACTICES).

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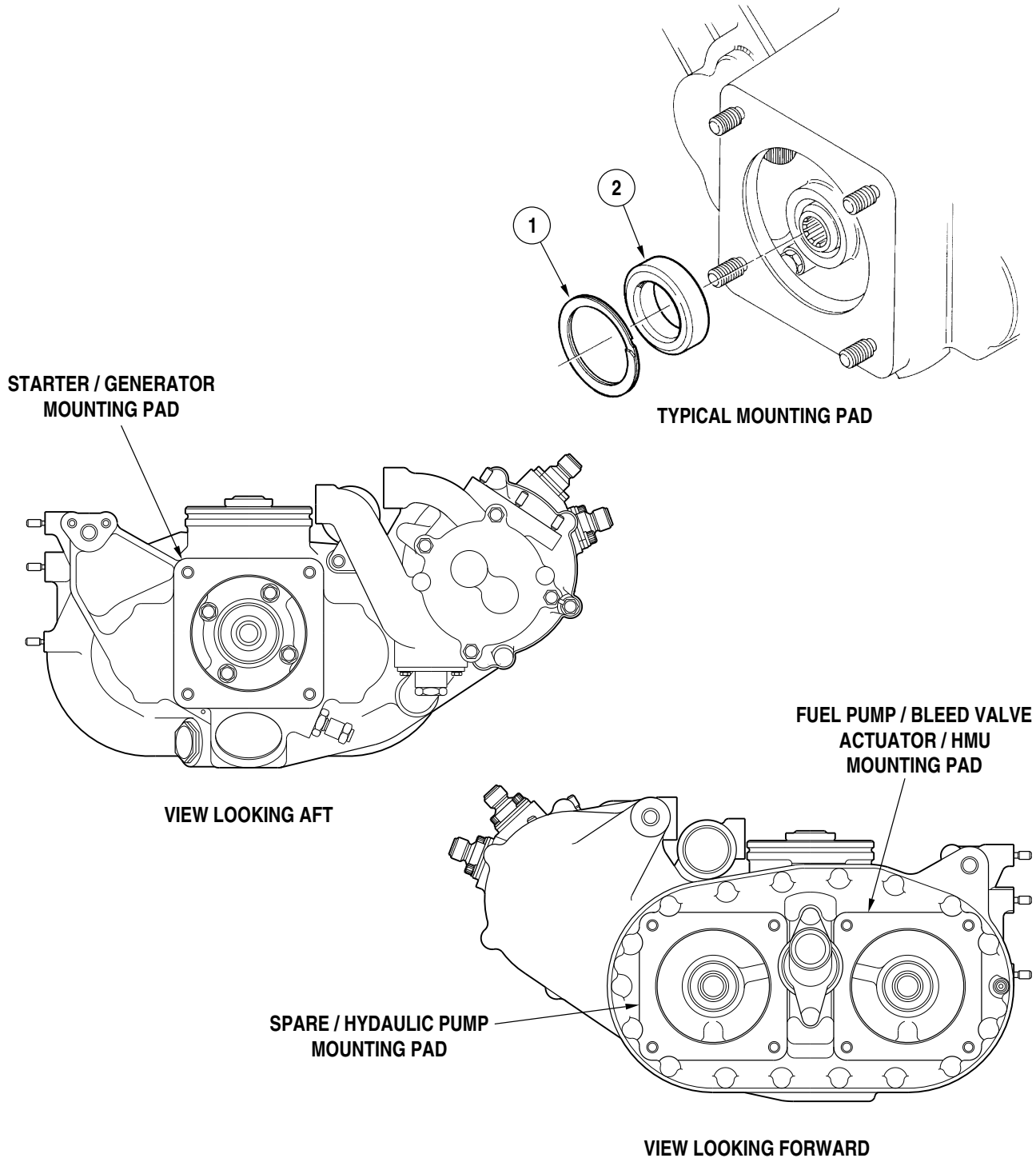

Accessory Drive Seals (Typical)
Figure 202

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Key to Figure 202

1. Retaining Ring
2. Seal

E. Removal of Centrifugal Breather Gearshaft Carbon-Face Seal (Ref. Fig. 203)

(1) JT15D-5 (Pre-SB7280) engines: remove AGB breather hose (Ref. 72-60-01, Installation).

(2) JT15D-5 (Post-SB7280) and JT15D-5R engines: Disconnect extension tube from breather adapter (Ref. Airframe Maintenenance Manual).

(3) Remove two self-locking nuts (1) and washers securing breather adapter (2) to accessory gearbox cover assembly and remove adapter together with carbon-face seal (4). Remove and discard preformed packing (7) from adapter.

(4) Install breather adapter (2) in support (5) (PWC31063) and remove carbon-face seal (4) from adapter using puller (3) (PWC31061).

(5) Remove adapter (2) from support (5) (PWC31063).

F. Installation of Centrifugal Breather Gearshaft Carbon-Face Seal (Ref. Fig. 203)

CAUTION: HANDLE CARBON SEAL WITH CARE. DO NOT SCRATCH OR ALLOW SOLVENTS TO CONTACT SEAL.

(1) Freeze carbon-face seal (4) at -40°C for 15 minutes minimum.

(2) Heat breather adapter (2) in oven at 121°C to 149°C (250°F to 300°F) for 10 minutes minimum.

(3) Remove breather adapter (2) from oven and secure in support (5) (PWC31063). Install carbon-face seal (4) in breather adapter (2) using drift (6) (PWC31062). Allow to cool to room temperature, then remove breather adapter assembly from support.

(4) Immerse carbon-face seal (4) in engine oil (PWC03-001) and work seal in and out to ensure that element is free to travel within its casing.

(5) Install new preformed packing (7) on breather adapter (2). Install adapter on AGB with offset neck to top of AGB and secure with two washers and self-locking nuts (1). Tighten nuts and torque to 32 to 36 lb.in.

(6) JT15D-5 (Pre-SB7280) engines: install AGB breather hose (Ref. 72-60-01, Installation).

(7) JT15D-5 (Post-SB7280) and JT15D-5R engines: Install airframe extension tube on adapter (Ref. Airframe Maintenance Manual).

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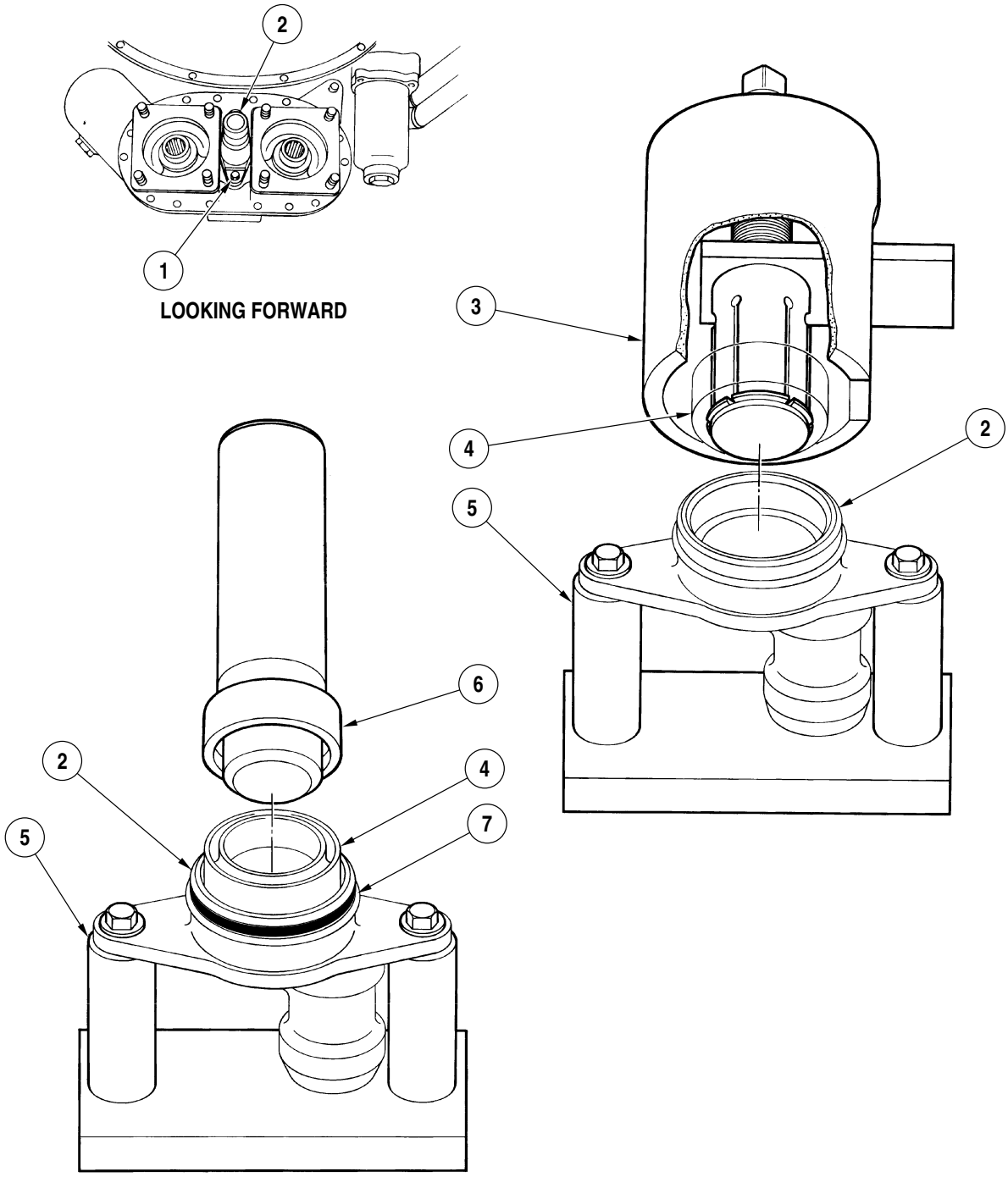

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Removal/Installation - Centrifugal Breather Gearshaft Carbon-Face Seal
Figure 203

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Key to Figure 203

1. Self-locking Nut
2. Breather Adapter
3. Puller
4. Carbon-face Seal
5. Support
6. Drift
7. Preformed Packing

G. Removal of Starter-Generator

(1) Refer to Airframe Maintenance Manual for procedures for removal or installation of starter-generator.

(2) Following removal, check gearshaft splines for wear.

(3) Use only engine oil (PWC03-001) to lubricate the starter-generator driveshaft splines.

(4) If starter-generator was replaced, perform required ground checks (Ref. 71-00-00, ADJUSTMENT/TEST, Ground Testing).

6. Cleaning/Painting

A. Oil Pump Inlet Strainer Sleeve

(1) Wash inlet strainer sleeve (Ref. Fig. 201) thoroughly in clean petroleum solvent (PWC11-027).

(2) Dry sleeve using clean, dry, filtered compressed air, or allow sleeve to air dry.

(3) Inspect sleeve for general condition, broken strands or dents. Damage of any kind is cause for rejection and replacement.

7. Approved Repairs

A. Oil Pump - Repair by Replacement

NOTE: The following procedure is to identify the source of and to correct a static oil leak from the AGB assembly. Perform this check when, after ensuring that the check valves (Ref. 79-20-02) are not leaking, oil pump may be source of leakage.

(1) Correct static oil leak from accessory gearbox: drain oil from gearbox and oil tank (Ref. 79-00-01, SERVICING); do not reinstall gearbox drain plug.

(2) Remove oil pump assembly (Ref. Para. 5.A.) and cap off supply line to oil pump.

NOTE: Use a plastic dust cap and a hose clamp to cap off supply line.

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(3) Refill tank with minimum of four quarts of engine oil (Ref. 79-00-01, OIL SYSTEM - SERVICING).

(4) Allow waiting period of three hours and check for oil leakage at AGB drain plug.

(a) If no oil leakage, oil pump assembly is defective and must be replaced (Ref. Para. 5.B.).

(b) If leakage is evident, refer to Chapter 72-00-00, FAULT ISOLATION, Static Oil Leak from Overboard Drains).

B. Repair of Corrosion - Accessory Gearbox Housing

NOTE: Corrosion must not be deeper than 0.010 inch and must not cover an area greater than 10% of the total surface of the AGB housing.

(1) Apply a suitable covering material on the compressor section.

(2) Clean surface to be repaired with a swab and/or crocus cloth (PWC05-061) soaked in isopropyl alcohol (PWC11-014).

(3) Remove all signs of corrosion (magnesium oxide) with a suitable crocus cloth (PWC05-061), abrasive cloth (PWC05-101), file or grit paper. Remove all signs of debris with a vacuum cleaner.

(4) Flush the area with clean water at room temperature.

(5) Dry the area with clean compressed air at 29 psig.

WARNING: REFER TO THE MATERIAL SAFETY DATA SHEETS BEFORE YOU USE THESE MATERIALS FOR INFORMATION SUCH AS HAZARDOUS INGREDIENTS, PHYSICAL/CHEMICAL CHARACTERISTICS, FIRE, EXPLOSION, REACTIVITY, HEALTH HAZARD DATA, PRECAUTIONS FOR SAFE HANDLING, USE AND CONTROL MEASURES. SOME OF THESE MATERIALS CAN BE DANGEROUS. YOU CAN GET THE DATA SHEETS FROM THE MANUFACTURERS OR THE SUPPLIERS OF THESE MATERIALS.

(6) Prepare a chrome pickle solution (Ref. 70-00-00, STANDARD PRACTICES - REPAIR).

(7) Use a swab or brush, apply the chrome pickle solution, at a temperature of 17° to 29°C (55° to 85°F), to the prepared surface for 30 to 45 seconds.

NOTE: Repeat the application frequently to make sure the affected surface is continually wet with the solution.

(8) Swab the area with clean water until successive swabs are no longer stained yellow.

(9) Dry the area with local heating (air dry or a heat gun at a low setting).

(10) Clean the affected area with a rag soaked in clean water.

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(11) Dry the area with clean, compressed air at 29 psig.

(12) Apply two coats of primer (PWC13-001).

NOTE: The primer can be diluted with 10% solvent.

(13) Allow the primer to air dry for eight hours before you apply the enamel paint. Use compressed air at 29 psig to accelerate the drying time.

(14) Apply three to four coats of enamel (PWC05-037) to the primed surface. Allow the surface of the enamel to become tacky (approximately 15 minutes) between each coat. The final coat of enamel must dry for 24 hours before returning the engine to service.

NOTE: Drying time for the primer and paint can be reduced with the use of a heat gun at a low setting. Refer to the manufacturers instructions.

8. Fits, Clearances and Torque Loadings

A. Refer to Table 201 and Figure 204.

TABLE 201, Fits and Clearances

REF. NO.	Name	Dim. for Ref. (inches)		Limits (inches)		
		Min.	Max.	Min.	Max.	Replace
7	Housing, Accessory Gearbox	1.6250	1.6260	0.0020T	0.0120T	
	Seal, Plain	1.6280	1.6370			
14	Adapter-Breather	1.6550	1.6570	0.0010	0.0050	
	Cover-Accessory Gearbox	1.6580	1.6600			
15	Seal-Face	1.3760	1.3780	0.0040T	0.0000	
	Adapter-Breather	1.3740	1.3760			
28	Cover, Accessory Gearbox	1.3740	1.3760	0.0020T	0.0120T	
	Seal, Plain	1.3780	1.3860			
1143	Pin, Grooved, Headless, 0.3736 x 5.900	0.3731	0.3736	0.0014	0.0024	
	Bushing, Sleeve (2 places) 0.3750 x 0.5010 x 1.1450	0.3750	0.3755			

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TABLE 202, Torque and Stretch

REF. NO.	Name	Limits Min.	Limits Max.
	Not Applicable		

TABLE 203, Spring Pressure

REF. NO.	Name	Limits Min.	Limits Max.
	Not Applicable		

TABLE 204, Special Assembly

REF. NO.	Name	Limits Min.	Limits Max.
	Not Applicable		

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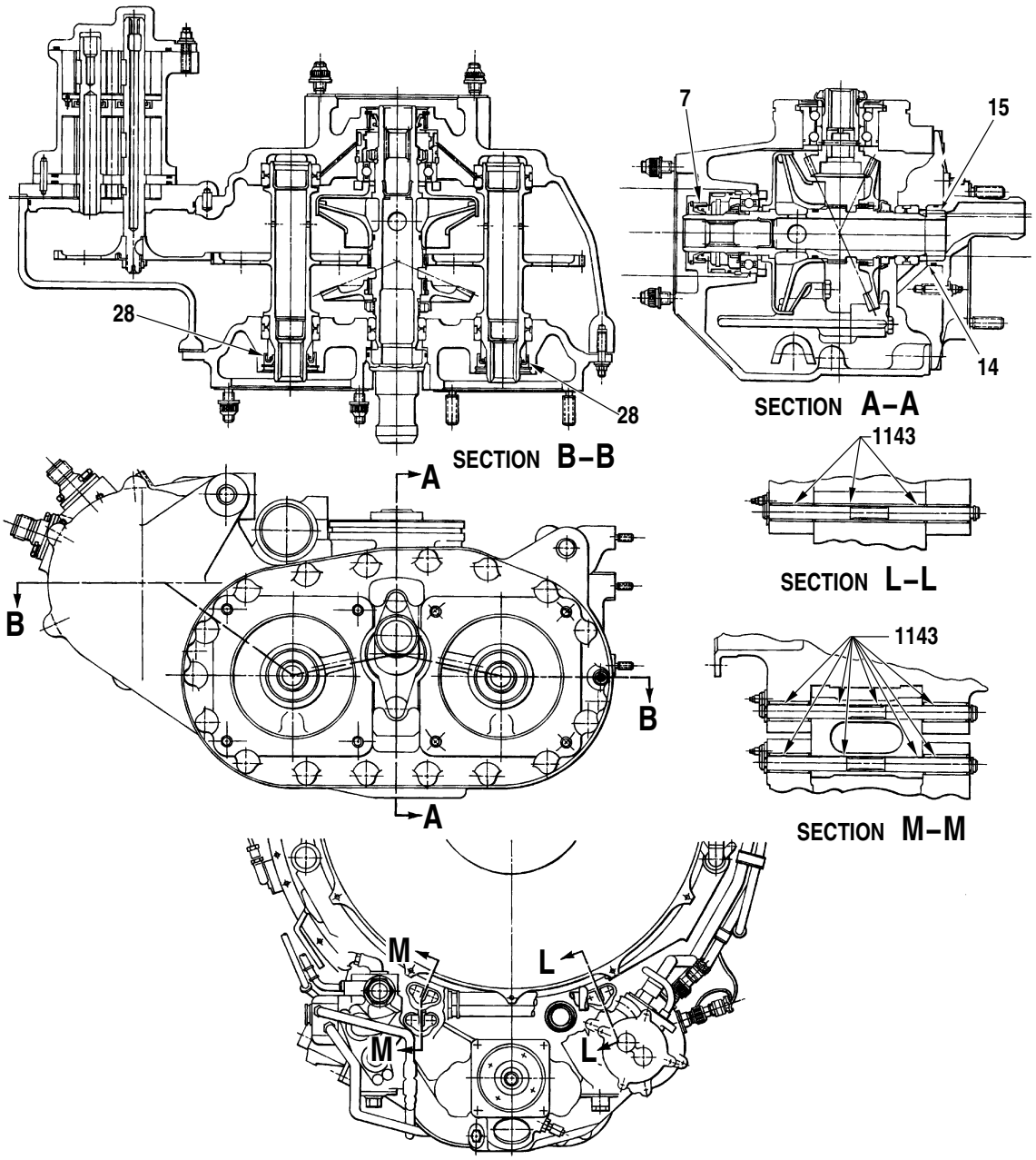

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Fits, Clearances and Torque Loadings
Figure 204

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
LEP	1	May 13/2013
	2 blank	May 13/2013
Contents	1	May 13/2013
	2	May 13/2013
	3	May 13/2013
	4 blank	May 13/2013
72-70-00	1	Oct 22/99
Description and	2	Oct 22/99
Operation		
72-70-01	1	Oct 06/2006
Description and	2	Oct 06/2006
Operation		
72-70-01	201	Oct 06/2006
Maintenance	202	Oct 06/2006
Practices	203	Oct 06/2006
	204	Oct 06/2006
	205	Oct 06/2006
	206	Oct 06/2006
72-70-02	1	Oct 22/99
Description and	2	Oct 22/99
Operation		
72-70-02	201	Oct 22/99
Maintenance	202	Oct 22/99
Practices	203	Oct 22/99
	204	Oct 22/99
	205	Oct 22/99
	206	Oct 22/99
72-70-03	1	Oct 06/2006
Description and	2	Oct 06/2006
Operation		
72-70-03	201	May 13/2013
Maintenance	202	May 13/2013
Practices	203	May 13/2013
	204 blank	May 13/2013
72-70-04	1	Oct 22/99
Description and	2 blank	Oct 22/99
Operation		
72-70-04	201	Oct 06/2006
Maintenance	202	Oct 06/2006
Practices	203	Oct 06/2006
	204	Oct 06/2006
	205	Oct 06/2006
	206	Oct 06/2006
	207	Oct 06/2006
	208 blank	Oct 06/2006

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TABLE OF CONTENTS

SUBJECT	PAGE
BYPASS SECTION - DESCRIPTION AND OPERATION	**72-70-00**
1. Description)	1
FRONT INNER BYPASS DUCT ASSEMBLY - DESCRIPTION AND OPERATION	**72-70-01**
1. Description	1
FRONT INNER BYPASS DUCT ASSEMBLY - MAINTENANCE PRACTICES	**72-70-01**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation (Heavy Maintenance Only)	201
A. Removal of Front Inner Bypass Duct	201
B. Installation of Front Inner Bypass Duct	203
6. Inspection/Check	203
A. Fretting Wear	203
7. Approved Repairs	203
A. Cracks	203
8. Fits, Clearances and Torque Loadings	205
REAR INNER BYPASS DUCT ASSEMBLY - DESCRIPTION AND OPERATION	**72-70-02**
1. Description)	1
REAR INNER BYPASS DUCT ASSEMBLY - MAINTENANCE PRACTICES	**72-70-02**
1. Removal/Installation (Heavy Maintenance Only)	201
A. Removal of Rear Inner Bypass Duct)	201
B. Installation of Rear Inner Bypass Duct)	201
2. Inspection/Check	201

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TABLE OF CONTENTS

SUBJECT	PAGE
REAR INNER BYPASS DUCT ASSEMBLY - MAINTENANCE PRACTICES (Cont'd)	**72-70-02**
A. Cracks	201
3. Approved Repairs	201
A. Cracks	201
B. Floating Plate Nuts - Replacement	201
4. Fits, Clearances and Torque Loadings	203
OUTER BYPASS DUCT ASSEMBLY - DESCRIPTION AND OPERATION	**72-70-03**
1. Description	1
A. General	1
B. PsD Sensing System	1
OUTER BYPASS DUCT ASSEMBLY - MAINTENANCE PRACTICES	**72-70-03**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Inspection/Checks	201
A. Internal and External Surfaces	201
6. Approved Repairs	201
A. Mounting Pad Flanges Exhibiting Bond Separation :	201
ENGINE REAR MOUNT INSTALLATION - DESCRIPTION AND OPERATION	**72-70-04**
1. Description	1
ENGINE REAR MOUNT INSTALLATION - MAINTENANCE PRACTICES	**72-70-04**
1. General	201
2. Consumable Materials	201

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
ENGINE REAR MOUNT INSTALLATION - MAINTENANCE PRACTICES (Cont'd)	**72-70-04**
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation (Heavy Maintenance Only)	201
A. Removal of Engine Rear Mount	201
B. Installation of Engine Rear Mount	203
6. Inspection/Check	204
A. Procedure	204
7. Fits, Clearances and Torque Loadings	204

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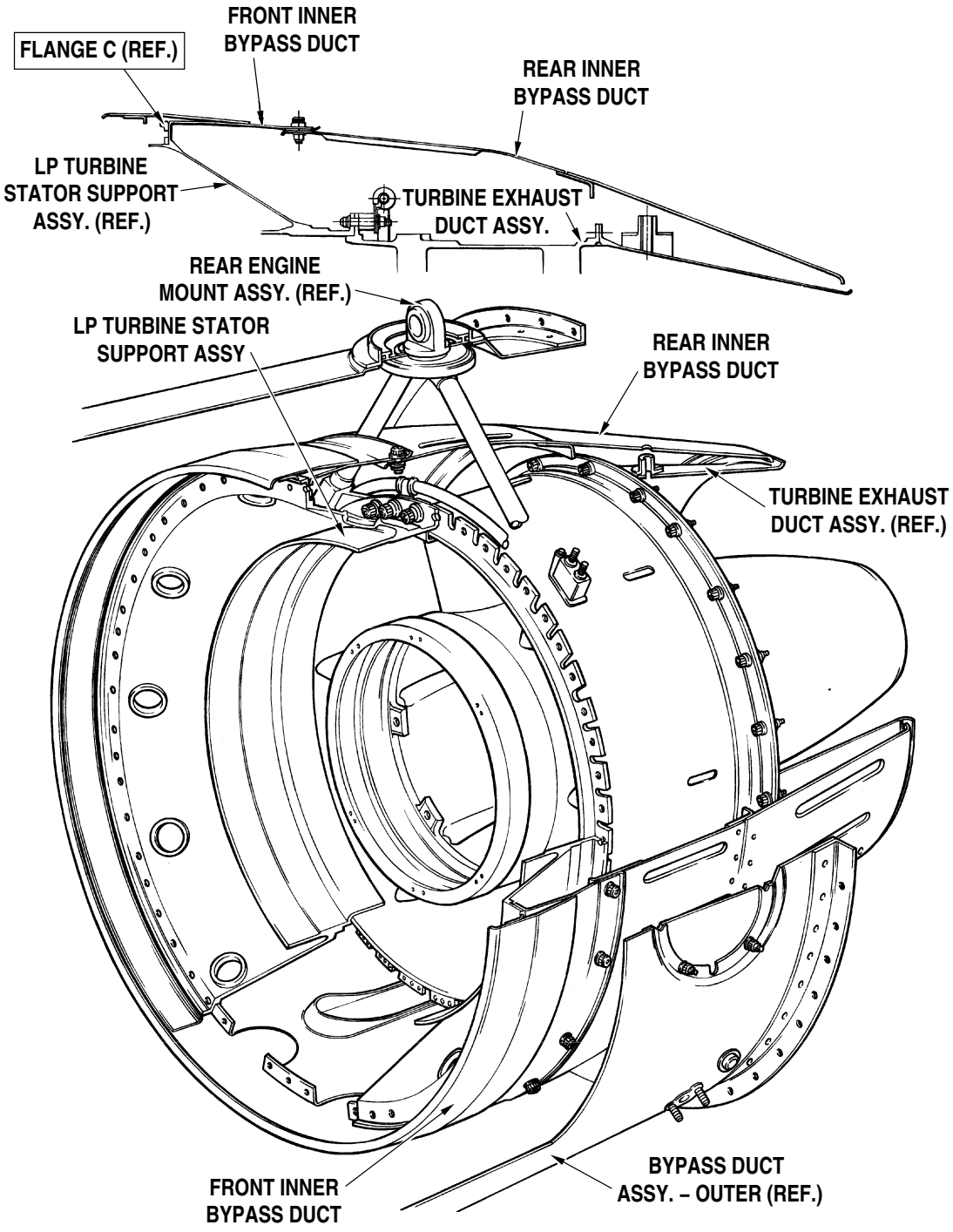
BYPASS SECTION - DESCRIPTION AND OPERATION

1. Description (Ref. Fig. 1)

The engine bypass duct consists of an annular outer assembly secured to the intermediate case rear flange and a two-piece annular inner assembly, the forward part of which is secured to the low pressure turbine stator support assembly at flange C. An airframe-supplied bypass nozzle is secured to the rear flange of the outer assembly. The total configuration forms a full length bypass duct through which secondary air is propelled and discharged to atmosphere.


FLANGE C (REF.)
FRONT INNER BYPASS DUCT
REAR INNER BYPASS DUCT
LP TURBINE STATOR SUPPORT ASSY. (REF.)
TURBINE EXHAUST DUCT ASSY.
REAR ENGINE MOUNT ASSY. (REF.)
LP TURBINE STATOR SUPPORT ASSY
REAR INNER BYPASS DUCT
TURBINE EXHAUST DUCT ASSY. (REF.)
FRONT INNER BYPASS DUCT
BYPASS DUCT ASSY. – OUTER (REF.)

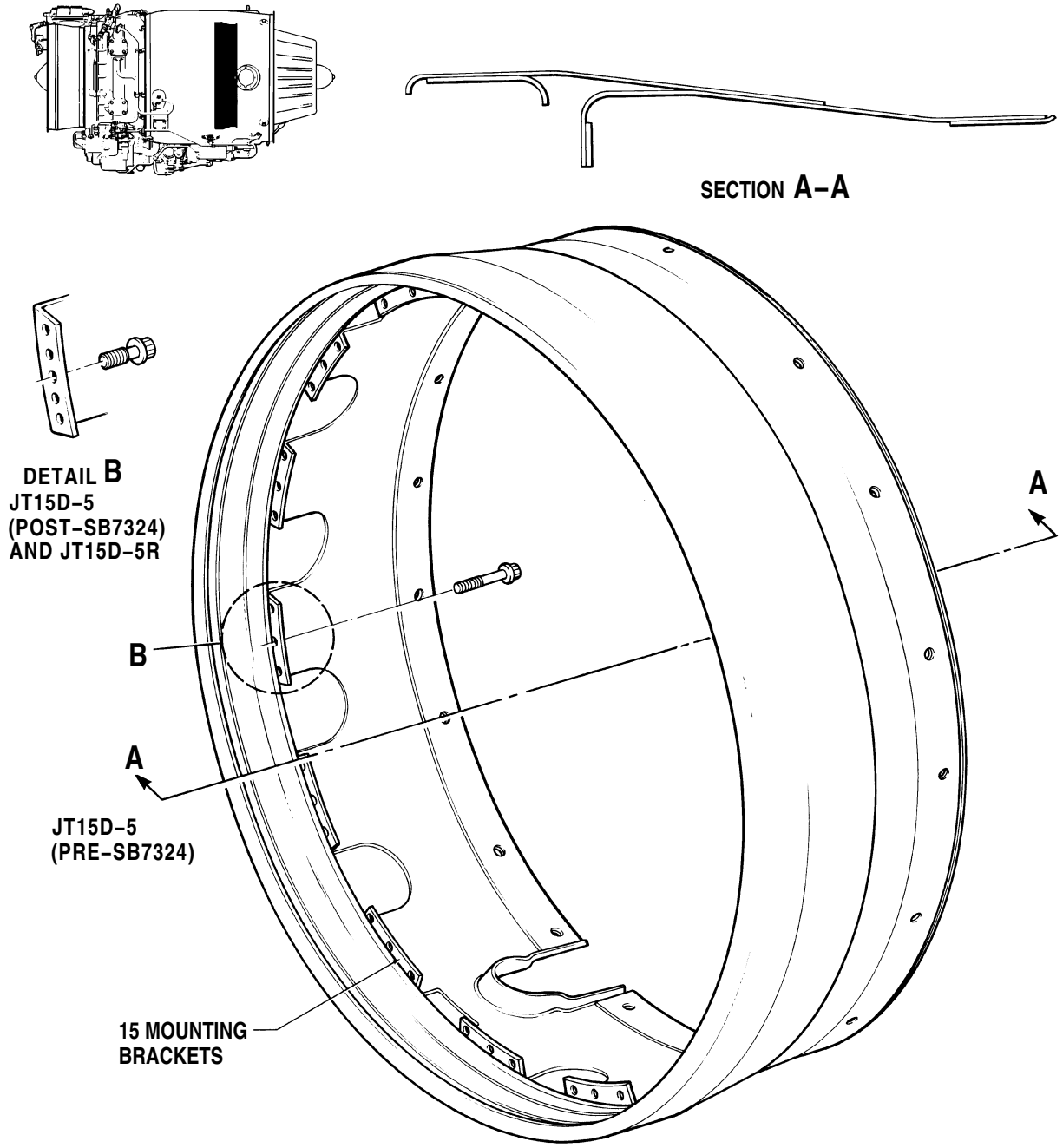
C11498A

Engine Bypass Duct Assembly
Figure 1

FRONT INNER BYPASS DUCT ASSEMBLY - DESCRIPTION AND OPERATION

1. Description (Ref. Fig. 1)

   Two sheet metal assemblies comprise the inner bypass duct between flange C and the exhaust duct rear flange. A welded cone, located on the inner circumference of the inner duct assembly, has 15 integral and equally spaced flanged lugs for attachment to the LP turbine stator support assembly at flange C; the lugs are reinforced by welded segment plates. The rear of the duct is drilled for attachment to the rear inner bypass duct, using 18 bolts.



C11463B

Front Inner Bypass Duct Assembly
Figure 1

FRONT INNER BYPASS DUCT ASSEMBLY - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the front inner bypass duct assembly

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC05-158	Steel Sheet
PWC05-159	Steel Sheet
PWC05-215	Filler Rod

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation (Heavy Maintenance Only)

   NOTE: The front inner bypass duct is normally only removed at Hot Section Inspection (HSI).

   A. Removal of Front Inner Bypass Duct (Ref. Fig. 201)

      (1) Complete removal procedures for LP turbine stator support assembly up to and including engine rear mount (Ref. 72-40-01).

      (2) Remove bolts (1) and retain or discard at HSI as follows:

         (a) JT15D-5 (Pre-SB7324) engines:

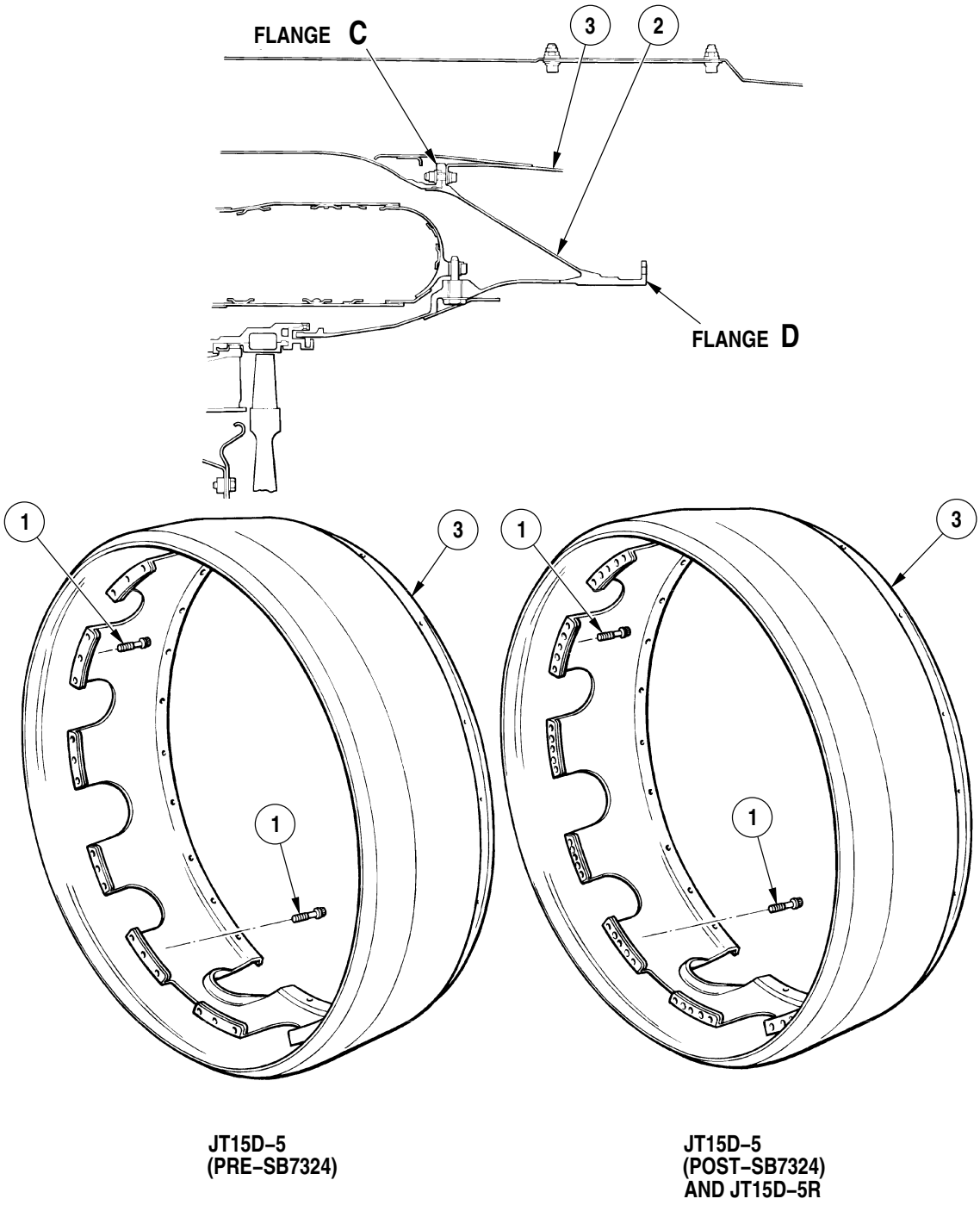
            1 For Pre-SB7250 or Post-SB7250 and Pre-SB7245 or Post-SB7245 engines: at HSI, remove and discard 45 bolts in 15 groups of three.

            2 For Post-SB7249 engines incorporating P/N MS9696-09 bolts: at HSI, remove and discard 45 bolts at HSI in15 groups of three.

            3 For Post-SB7249 engines incorporating P/N 3111850-01 bolts: at HSI, remove and discard 45 bolts in 15 groups of three.

         (b) JT15D-5 (Post-SB7324) and JT15D-5R engines: remove 75 bolts (1) from flange C in 15 groups of five. Retain bolts at HSI.

      (3) Remove front inner bypass duct (3).



C11397B

Removal/Installation - Front Inner Bypass Duct
Figure 201

Key to Figure 201

1. Bolt
2. LP Turbine Stator Support Assembly
3. Front Inner Bypass Duct

B. Installation of Front Inner Bypass Duct (Ref. Fig. 201)

(1) If removed, install LP turbine stator support assembly (Ref. 72-40-01).

(2) Install front inner bypass duct (3), with fuel tube cut-out in the six o'clock position.

(3) Secure front inner bypass duct (3) as follows:

(a) For JT15D-5 (Pre-SB7324) engines:

1 For Post-SB7249 engines incorporating P/N 3111850-01 bolts only: install 45 existing bolts in 15 groups of three.

2 For all other engines, install 45 new bolts in 15 groups of three.

(b) For JT15D-5 (Post-SB7324) and JT15D-5R engines: install 75 existing bolts bolts (1) in 15 groups of five.

(4) Tighten and torque bolts 180 degrees apart in a star pattern (REF. NO. 1740, Table 202).

(5) Install all previously removed components (Ref. 72-40-01).

6. Inspection/Check

A. Fretting Wear

(1) Inspect area around 18 bolt holes on rear flange of front inner bypass duct for fretting wear and/or cracks.

(2) If fretting wear and/or cracking is evident, refer to Paragraph 7.following.

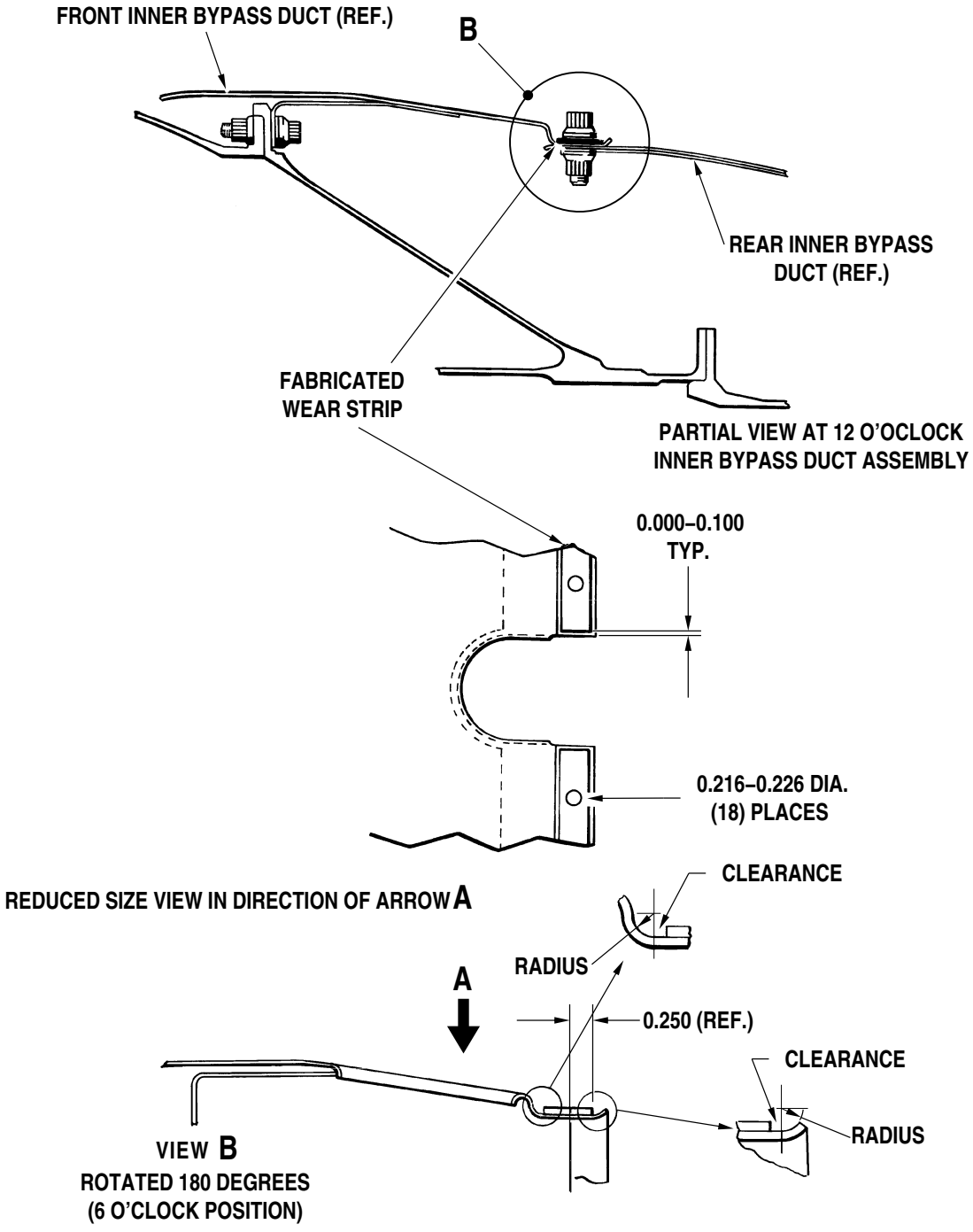
7. Approved Repairs

A. Cracks (Ref. Fig. 202)

(1) Repair front inner bypass duct cracks by stop-drilling ends of cracks, using 1/16 (0.0625) inch drill. Tungsten inert gas (TIG) weld cracks, using filler rod (PWC05-215). Blend weld flush with parent metal.

(2) Fabricate a sacrificial wear strip from steel (PWC05-158) or (PWC05-159) 0.022 to 0.025 inch thick, 0.470 to 0.530 inch wide by 63.190 to 63.310 inch long.

(3) Install wear strip (see view B) by locating centrally around the 18 hole area, commencing at cut-out (scallop) and secure with suitable clamps.



C9512A

Front Inner Bypass Duct - Repairs
Figure 202

(4) Using a 7/32 (0.218) inch drill, transfer 18 holes from duct to strip. Remove strip from duct and deburr holes as necessary. Break sharp edges 0.003 - 0.010 inch.

(5) At assembly of rear inner bypass duct into front inner bypass duct, install fabricated wear strip (Ref. Fig. 202).

8. Fits, Clearances and Torque Loadings

A. Refer to Table 202 and Figure 203.

TABLE 201, FITS AND CLEARANCES

REF. NO.	Name	Dim. for Ref. (inches)		Limits (inches)		
		Min.	Max.	Min.	Max.	Replace
Not Applicable						

TABLE 202, TORQUE AND STRETCH

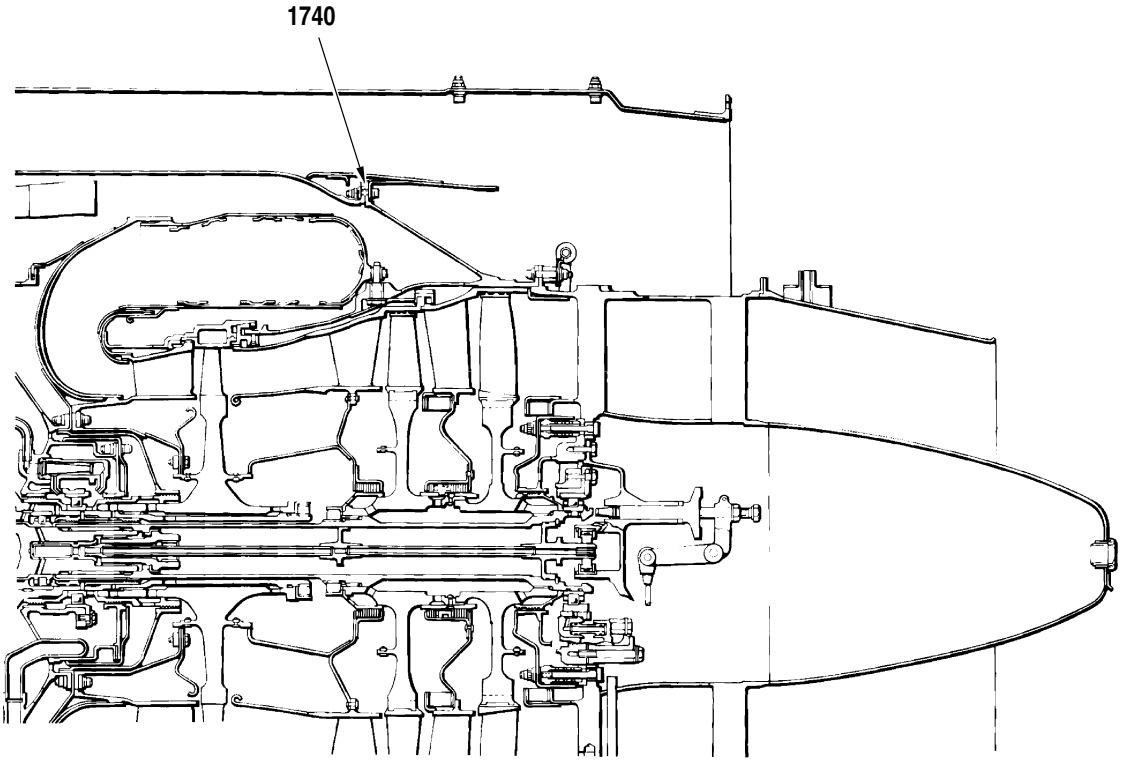
REF. NO.	Name	Limits	
		Min.	Max.
1740	Bolts, Gas Generator Case, LPT Stator Support	46 lb.in	52 lb.in.

TABLE 203, SPRING PRESSURE

REF. NO.	Name	Limits	
		Min.	Max.
Not Applicable			

TABLE 204, SPECIAL ASSEMBLY

REF. NO.	Name	Limits	
		Min.	Max.
Not Applicable			



C21492

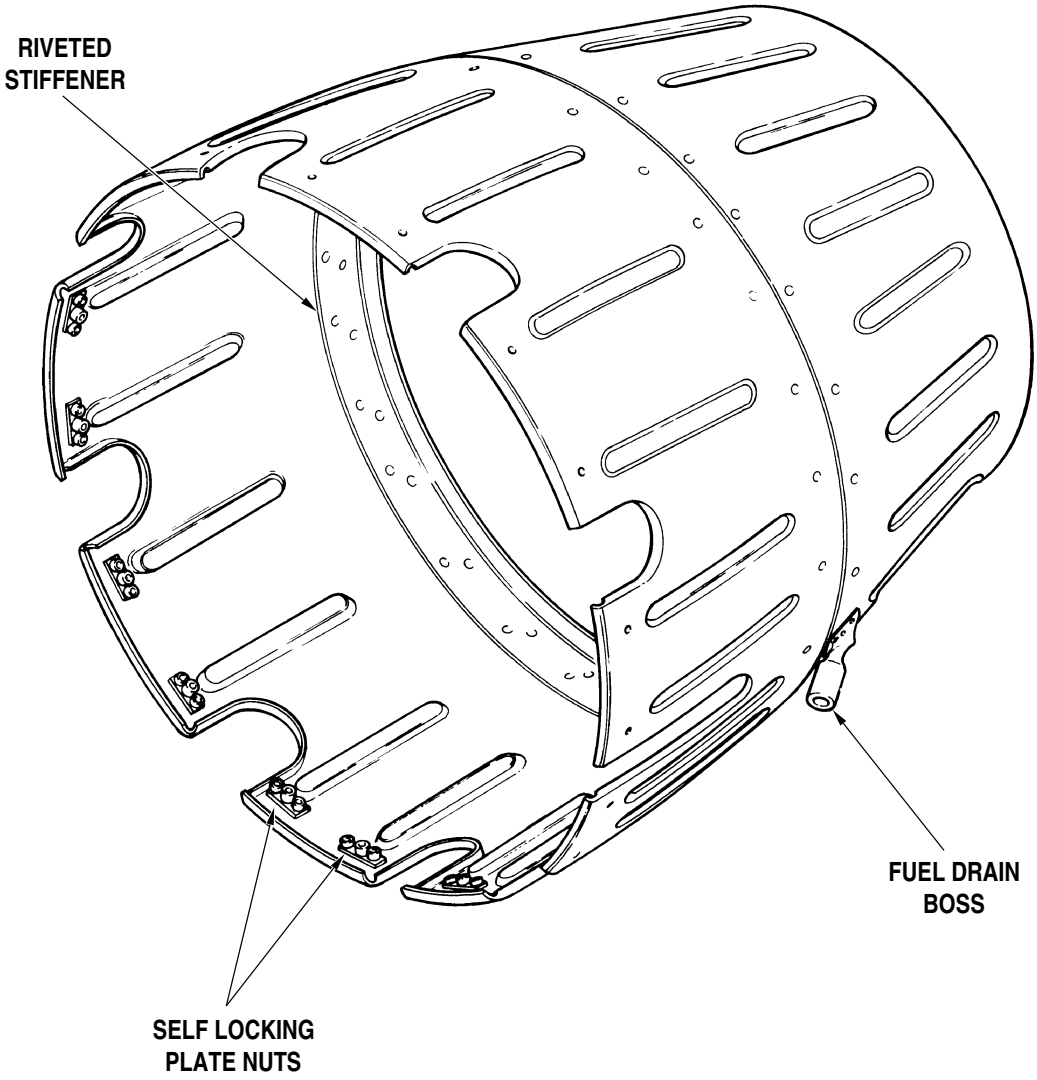
Fits, Clearances and Torque Loadings
Figure 203

REAR INNER BYPASS DUCT ASSEMBLY - DESCRIPTION AND OPERATION

1. Description (Ref. Fig. 1)

The rear inner bypass duct is an annular aluminum alloy sheet metal assembly, formed by two pieces joined by an angular riveted stiffener. Eighteen floating plate nuts are riveted to the front of the duct, which is secured to the front inner bypass duct with bolts.

Cut-outs at the leading edge of the duct permit alternative rear engine mount installation and provide passages for the No. 4 bearing oil tubes and the manifold fuel supply and shut-off system. The duct features a boss at 6 o'clock position to receive the exhaust duct fuel drain tube assembly.



C12636A

Rear Inner Bypass Duct Assembly
Figure 1

REAR INNER BYPASS DUCT ASSEMBLY - MAINTENANCE PRACTICES

1. Removal/Installation (Heavy Maintenance Only)

   A. Removal of Rear Inner Bypass Duct (Ref. Fig. 201)

      (1) Unlock keywasher (7). Remove bolt (6), keywasher (7) and plate (8) securing fuel drain tube (5) to outer bypass duct (1). Push drain tube upward into boss on rear inner bypass duct (3).

      (2) Remove 18 bolts (2) securing rear inner bypass duct (3) to front inner bypass duct and remove rear inner duct.

      (3) Remove fuel drain tube (5) with two preformed packings (4). Remove and discard packings.

   B. Installation of Rear Inner Bypass Duct (Ref. Fig. 201)

      (1) Check all floating plate nuts on rear inner bypass duct (3) front end. Replace missing or damaged nuts (Ref. Para. 3.).

      (2) Install two new preformed packings (4) on fuel drain tube (5) and install tube in boss on rear inner bypass duct (3), inside front inner bypass duct. Align bolt holes, centralize rear inner bypass duct and install fuel drain tube in boss on outer bypass duct (1) and 18 bolts (2). Tighten bolts 180 degrees apart, using star pattern, and torque 32 to 36 lb.in.

      (3) Install plate (8), keywasher (7) and bolt (6). Torque bolt 24 to 36 lb.in. and lock keywasher.

2. Inspection/Check

   A. Cracks

      (1) Hairline cracks beginning at edge of rear flange are acceptable provided they do not enter beyond the radius .

      (2) Hairline cracks beginning at edge of rear flange extending beyond the radius to a maximum length of 1.0 inch should be repaired (Ref. Para. 3.).

3. Approved Repairs

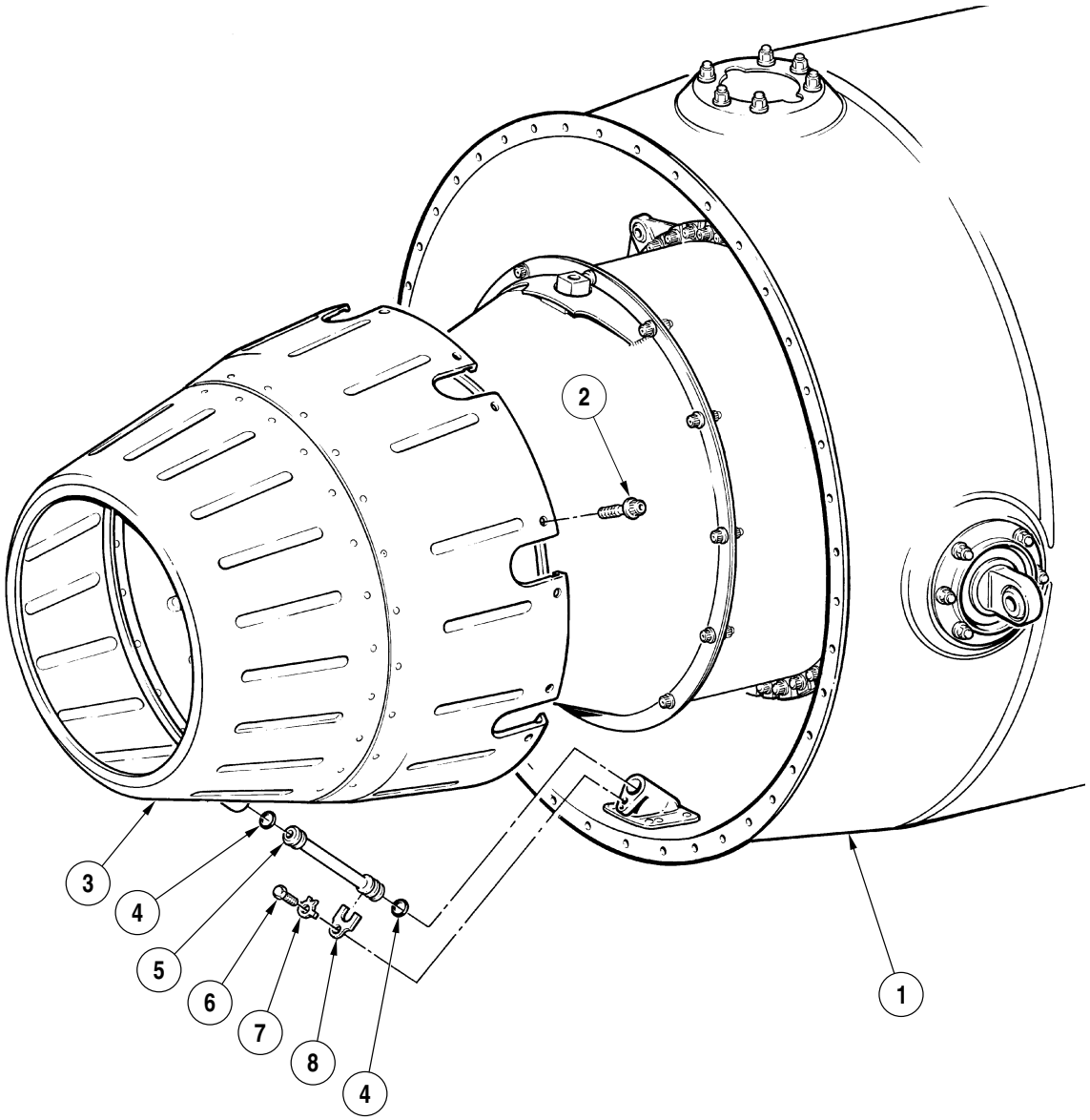
   A. Cracks

      (1) Repair rear inner bypass duct cracks by stop drilling end of crack using a 1⁄8 (0.125) inch drill.

   B. Floating Plate Nuts - Replacement

      (1) Drill manufactured head of two rivets securing plate nut using a 3/32 inch drill. Remove rivets using suitable punch. Remove and discard plate nut.

      (2) Install new plate nut and secure to rear outer bypass duct with two rivets.



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Removal/Installation - Rear Inner Bypass Duct Assembly
Figure 201

Key to Figure 201

1. Outer Bypass Duct
2. Bolt
3. Rear Inner Bypass Duct
4. Preformed Packing
5. Transfer Tube
6. Bolt
7. Keywasher
8. Plate

4. Fits, Clearances and Torque Loadings

A. Refer to Table 201 and Figure 203.

TABLE 201, Fits and Clearances

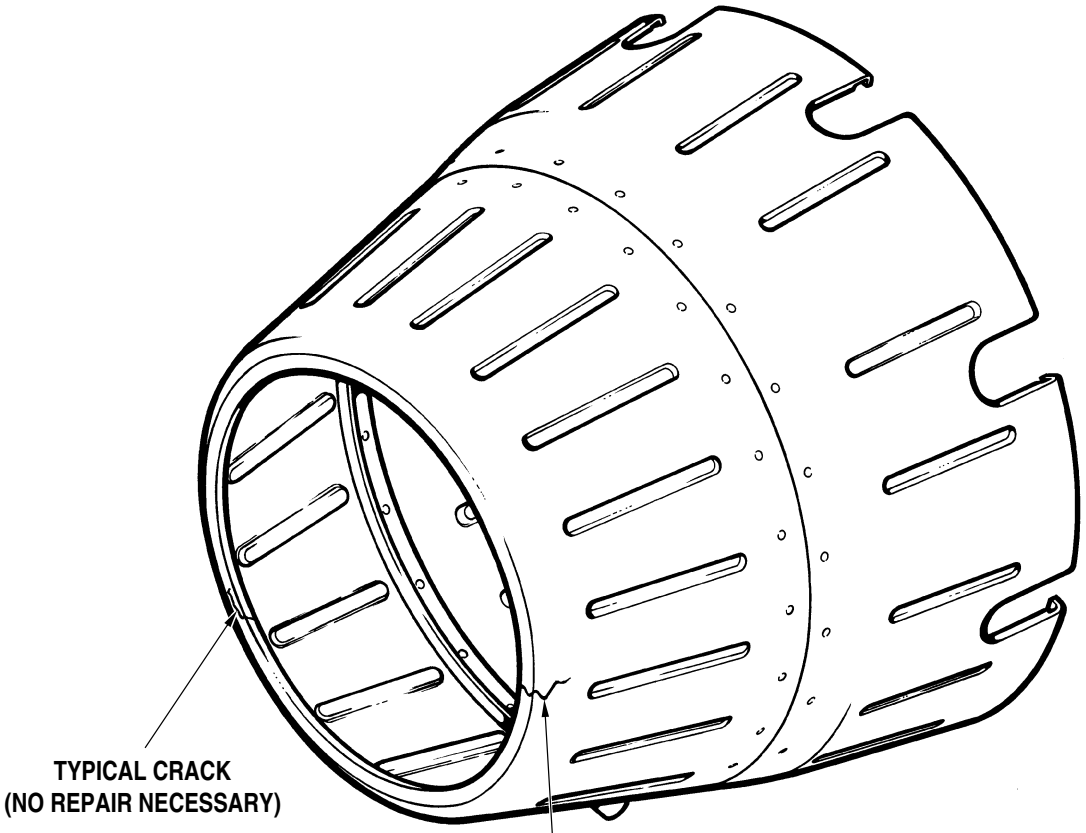
REF. NO.	Name	Dim. for Ref. (inches)		Limits (inches)		
		Min.	Max.	Min.	Max.	Replace
1100	Duct Assembly, Bypass Front Inner	21.2400	21.2500	0.0200L	0.0200T	
	Duct Assembly, Bypass Rear Inner	21.2300	21.2600			

TABLE 202, Torque and Stretch

REF. NO.	Name	Limits	
		Min.	Max.
Not Applicable			

TABLE 203, Spring Pressure

REF. NO.	Name	Limits	
		Min.	Max.
Not Applicable			

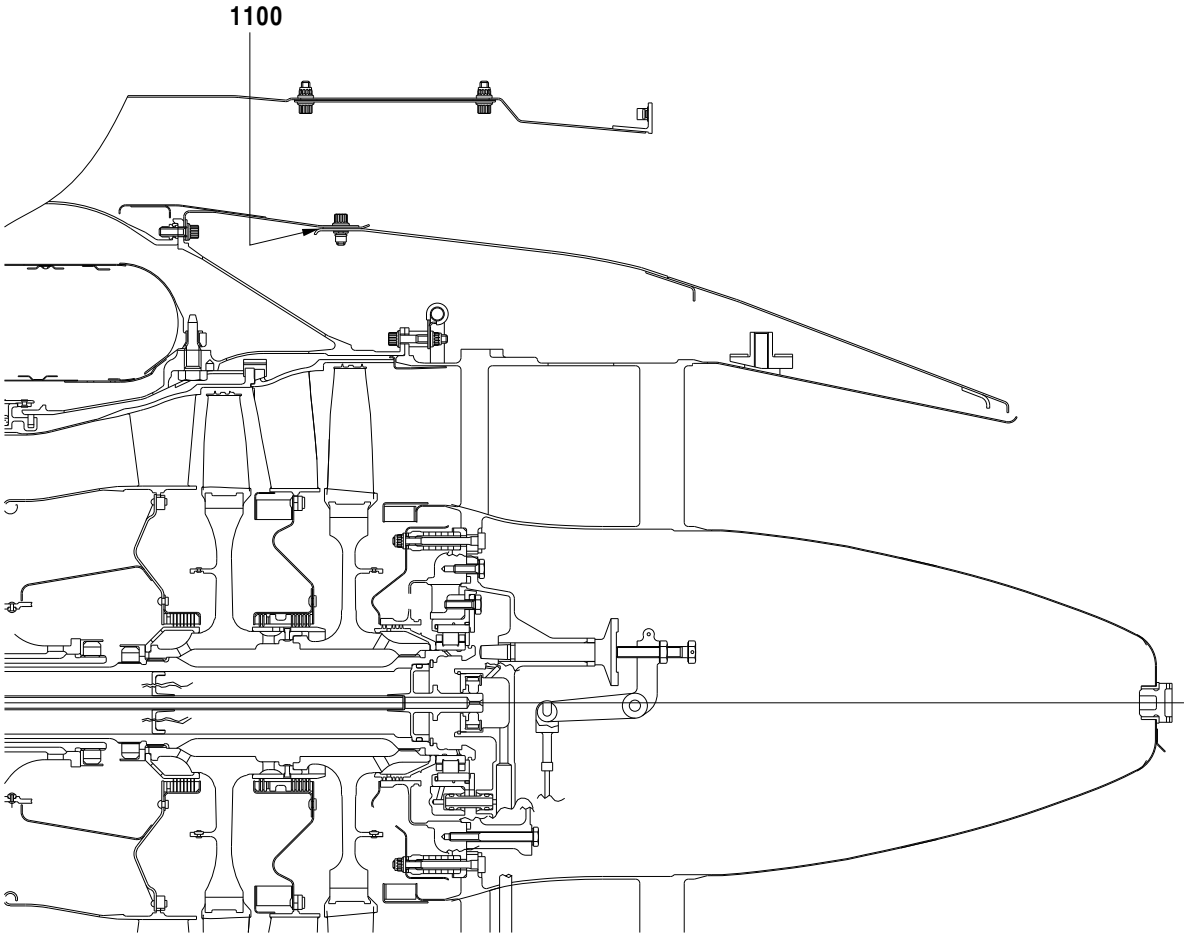


C12637

Rear Inner Bypass Duct - Inspection/Repair
Figure 202

TABLE 204, Special Assembly

REF. NO.	Name	Limits Min.	Limits Max.
Not Applicable			



C32779

Fits, Clearances and Torque Loadings
Figure 203

OUTER BYPASS DUCT ASSEMBLY - DESCRIPTION AND OPERATION

1. Description (Ref. Fig. 1)

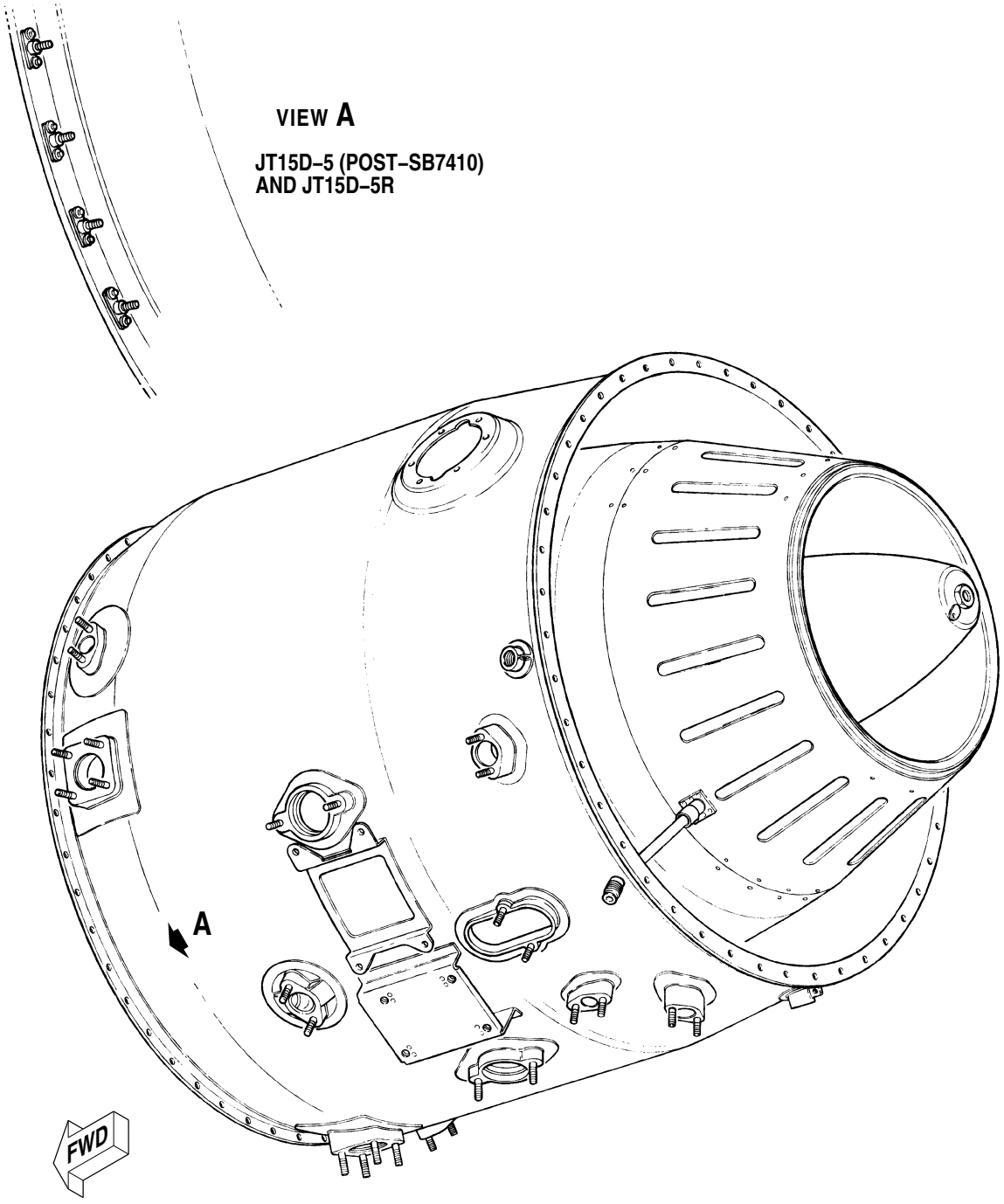
   A. General

   The outer bypass duct consists of an annular aluminum sheet metal assembly with flanges at the front and rear. The front flange is bolted to the rear outer flange of the intermediate case. The rear flange provides the means of attachment for the airframe-supplied bypass nozzle. Various bosses are provided around the circumference of the duct for accessories and other external fittings. On JT15D-5 (Pre-SB7222) engines only, four drain holes are located on the deflector boss at rear of duct.

   B. PsD Sensing System

   Three bosses are mounted on the rear of the outer bypass duct at the 4, 7 and 11 o'clock positions respectively. The bosses at the 4 and 11 o'clock positions can be connected to the boss at the 7 o'clock position by pressure sensing tubes and an airframe-supplied connection can be made at this location.

   The JT15D-5 engine does not feature pressure sensing tubes and thus the tube apertures in the three bosses are plugged.



VIEW ON UNDERSIDE

C22722A

Outer Bypass Duct Assembly
Figure 1

OUTER BYPASS DUCT ASSEMBLY - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the outer bypass duct.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC08-006	Epoxy Adhesive
PWC11-005	Envirosolv 655
PWC11-012	Acetone
PWC11-014	Isopropyl Alcohol
PWC11-022	DELETED
PWC11-023+	Ardrox Leeder 1064K
PWC11-025+	Desoclean 45

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Inspection/Checks

   A. Internal and External Surfaces

      (1) Check for damage with particular attention to bonded joints. There must be no separation at bonds. Repair unbonded bypass duct mounting pads (Ref. Para. 6.).

6. Approved Repairs

   A. Mounting Pad Flanges Exhibiting Bond Separation (Ref. Fig. 201):

      (1) Drill rivet holes at approximately 1 inch intervals along the separated area using a (1⁄8) (0.125) inch diameter drill. De-burr and break sharp edges as required.

         NOTE: Insert suitable suction tube sufficient to remove any particles produced by drilling.

      (2) Prepare mating surface of bypass duct and mounting pad flange as follows:

         (a) If separation exceeds 25 percent of bonded area, remove pad completely from bypass duct. Thoroughly clean mating faces of pad and duct with a wire brush and swab with isopropyl alcohol (PWC11-014).

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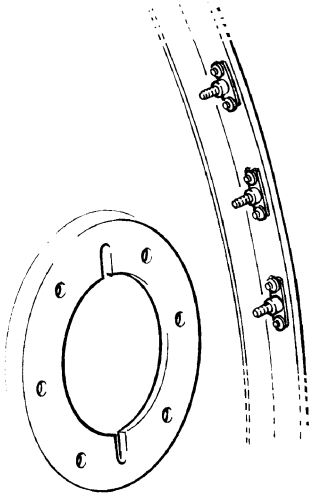
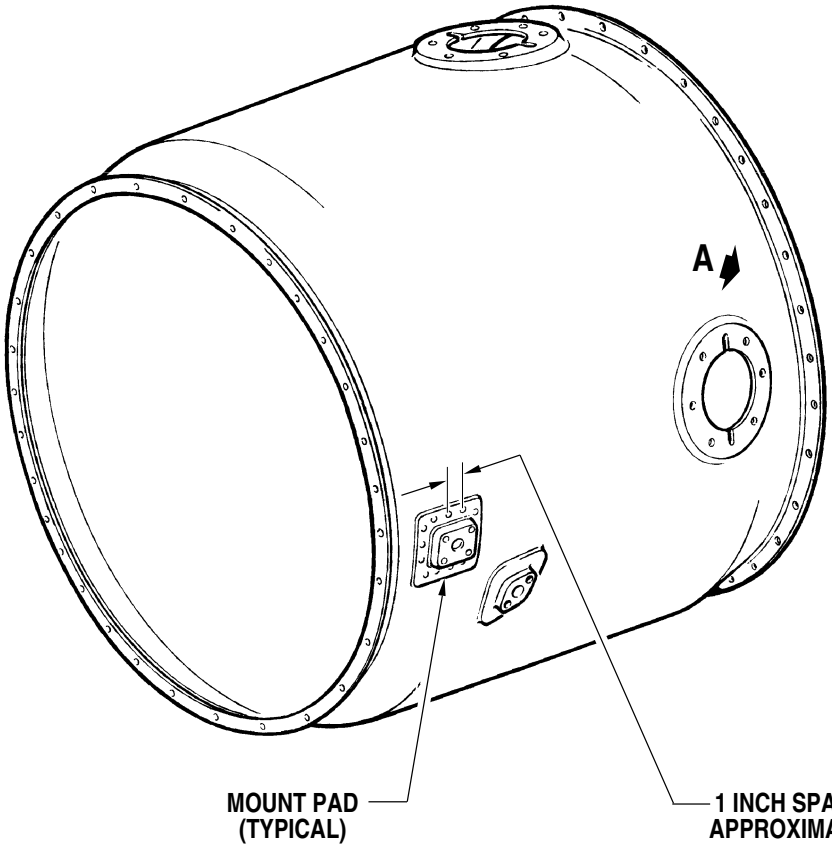


VIEW A

**JT15D–5 (POST–SB7410)
AND JT15D–5R**



C22717A

Outer Bypass Duct Assembly - Mounting Pad Flange Repair
Figure 201

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(b) If separation does not exceed 25 percent, remove old bond material and extraneous matter from separated areas by scraping with a strip of steel shim stock or similar thin material. Clean as thoroughly as separation permits.

WARNING: USE ADHESIVE IN WELL VENTILATED AREA AS THIS PRODUCT EMITS HARMFUL VAPORS. OBSERVE MANUFACTURER'S SAFETY INSTRUCTIONS.

(3) Coat mating surfaces with epoxy adhesive (PWC08-006). Secure flange to duct with suitable temporary fasteners and observe manufacturer's instructions regarding curing cycle before riveting.

CAUTION: WHEN USING CLEANING SOLVENTS ENSURE THAT THE APPROPRIATE HANDLING PRECAUTIONS ARE OBSERVED.

(4) Install rivets (Ref. Illustrated Parts Catalog, Part No. 3033443) with cherry rivet gun G-36 and puller No. H615B-4U. Upset rivets and clean off surplus weld with isopropyl alcohol (PWC11-014) or acetone (PWC11-012) or Ardrox Leeder 1064K (PWC11-023+) or Desoclean 45 (PWC11-025+) or Envirosolv 655 (PWC11-005+).

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ENGINE REAR MOUNT INSTALLATION - DESCRIPTION AND OPERATION

1. Description

The engine rear mount assembly consists of the engine mount and two hollow rods, each with a threaded rod-end clevis, forming a V-shaped assembly. The assembly can be secured to two of the four permanently mounted engine rear mount brackets on Flange D to permit the to be hung from the top or mounted on the side. The rods extend through the rear inner bypass duct, and the engine mount protrudes through a boss on the bypass duct. Two unused bosses on the bypass duct are sealed with covers.

ENGINE REAR MOUNT INSTALLATION - MAINTENANCE PRACTICES

1. General

   A. The following describes removal/installation of the rear engine mount for engine heavy maintenance. To locate rear engine mount before or after installation in shipping container, or to convert left and right-hand engines, refer to Chapter 72-00-00, REMOVAL/INSTALLATION.

2. Consumable Materials

   Not Applicable

3. Special Tools

   The special tools listed below are used in the following procedures.

Tool No.	Name	Application
PWC31260	Extractor	JT15D-5 (Pre-SB7322)
PWC31262	Puller	JT15D-5 (Pre-SB7322)

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation (Heavy Maintenance Only)

   A. Removal of Engine Rear Mount (Ref. Fig. 201)

      (1) If engine heavy maintenance is performed while engine is on-wing, remove hardware securing engine rear mount to airframe (Ref. Airframe Maintenance Manual).

      (2) Remove retaining ring (14) and seal plate retaining ring (13).

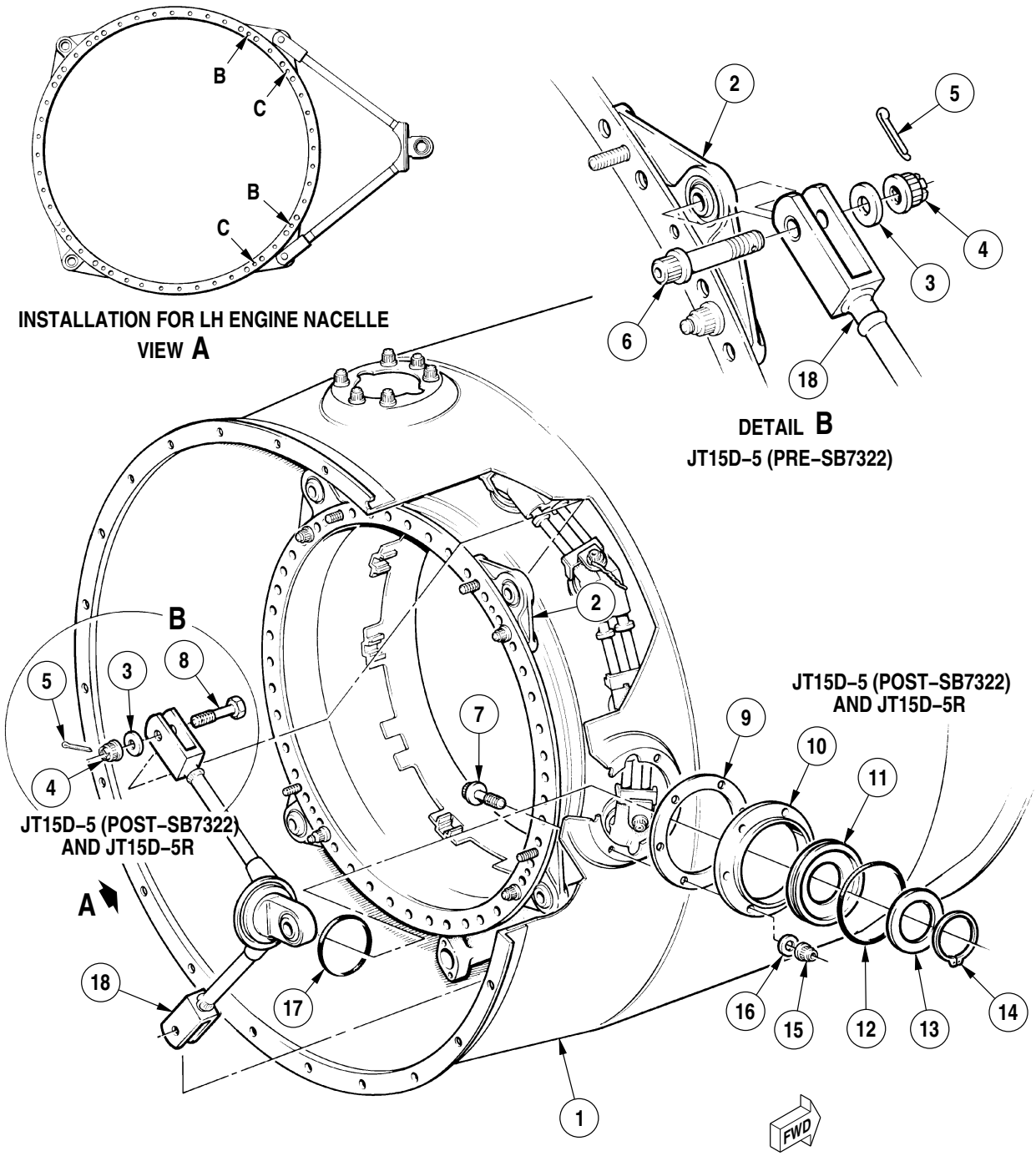
      (3) Remove six self-locking nuts (15), washers (16) and bolts (6) securing side mount flange (10) and JT15D-5 (Post-SB7222) or JT15D-5R gasket (9) to boss on outer bypass duct (1).

      NOTE: Separate side mount flange from outer bypass duct as engine rear mount is removed. Use of prying tool to separate flanged plate from outer bypass duct may damage duct.

      CAUTION: HOLD BOLT WHILE LOOSENING CASTELLATED NUT. BOLT SHANK WILL BE DAMAGED IF NUT IS HELD WHILE BOLT LOOSENED.

      (4) Remove two cotterpins (5) from castellated nuts (4). Hold bolts (6) or (8) and loosen castellated nuts. Remove nuts and washers (3).

      (5) JT15D-5 (Pre-SB7322) engines: remove two bolts (6) using puller (PWC31262) and extractor (PWC31260).



C21605A

Removal/Installation of Rear Engine Mount
Figure 201

Key to Figure 201

1. Outer Bypass Duct
2. Rear Engine Mount Bracket
3. Washer
4. Castellated Nut
5. Cotterpin
6. Bolt, JT15D-5 (Pre-SB7322)
7. Bolt
8. Bolt, JT15D-5 (Post-SB7322) and JT15D-5R
9. Gasket, JT15D-5 (Post-SB7322) and JT15D-5R
10. Side Mount Flange
11. Rear Engine Mount Sealing Plate
12. Preformed Packing
13. Seal Plate Retaining Ring
14. Retaining Ring
15. Self-locking Nut
16. Washer
17. Preformed Packing
18. Rear Engine Mount

(6) JT15D-5 (Post-SB7322) and JT15D- 5R engines: remove two bolts (8) using soft-faced hammer and nonmetallic drift.

CAUTION: REMOVE ENGINE REAR MOUNT WITH CARE TO AVOID DAMAGING OUTER BYPASS DUCT SKIN.

(7) Lift engine rear mount (18) upward to separate side mount flange (10) from outer bypass duct (1). Remove side mount flange with sealing plate (11) and JT15D-5 (Post-SB7222) or JT15D- 5R gasket (9). Discard gasket.

(8) Separate side mount flange (10) and sealing plate (11). Remove and discard preformed packing (12) from sealing plate.

(9) Lift engine rear mount (18) so that struts enter two slots in boss on outer bypass duct (1). Rotate rear mount so that struts lift over LP turbine stator support flange, one at a time. Remove mount through rear of outer bypass duct.

(10) Remove preformed packing (17) from engine rear mount (18). Discard preformed packing.

B. Installation of Engine Rear Mount (Ref. Fig. 201)

(1) Install new preformed packing (17) on engine rear mount (18).

CAUTION: INSTALL ENGINE REAR MOUNT WITH CARE TO AVOID DAMAGING OUTER BYPASS DUCT SKIN.

(2) Align spherical bearings on rear engine mount brackets (2). Insert engine rear mount (18), rotate upward and lift struts into slots on outer bypass duct (1) boss. Position fork ends of struts over spherical bearings on mount brackets.

CAUTION: CHECK THAT BOLTS ARE IN GOOD CONDITION.

(3) Install two JT15D-5 (Pre-SB7322) bolts (6) (bolt heads to rear of engine mount) or two JT15D-5 (Post-SB7322) or JT15D-5R bolts (8) (bolt heads forward of engine mount) with washers (3) and castellated nuts (4). Torque nuts 125 to 170 lb.in. and secure with new cotterpins (5).

(4) If JT15D-5 (Post-SB7222) or JT15D-5R engine, install new gasket (9). Install side mount flange (10). Secure to outer bypass duct (1) with six bolts (7), washers (16) and self-locking nuts (15). Torque nuts 36 to 40 lb.in.

(5) Install new preformed packing (12) on sealing plate (11) and install in side mount flange (10). Install seal plate retaining ring (13) and secure to engine rear mount (18) with retaining ring (14).

(6) Secure rear engine mount to airframe (Ref. Airframe Maintenance Manual).

6. Inspection/Check

A. Procedure

(1) Check struts of rear engine mount for dents and distortion. Check bolt holes in rod-end clevises for burring and elongation.

(2) Check for loss of protective coating.

(3) Check that inner ring bearing moves freely.

7. Fits, Clearances and Torque Loadings

A. Refer to Tables 201, 204 and Figure 202.

TABLE 201, Fits and Clearances

REF. NO.	Name	Dim. for Ref. (inches)		Limits (inches)		
		Min.	Max.	Min.	Max.	Replace
1130	Bearing, Plain, Self-aligning	0.7495	0.7500	0.0000	0.0010T	
	Brackets, Rear Engine Mounts	0.7490	0.7495			

TABLE 201, Fits and Clearances (Cont'd)

REF. NO.	Name	Dim. for Ref. (inches)		Limits (inches)		
		Min.	Max.	Min.	Max.	Replace
1131	Bolt, Close Tolerance	0.3110	0.3115	0.0005	0.0015	
	Mount, Engine, Rear Assembly	0.3120	0.3125			
1132	Bolt, Close Tolerance	0.3110	0.3115	0.0005	0.0015	
	Bearing, Plain, Self-aligning	0.3120	0.3125			
1144	Bearing, Plain, Self-aligning	0.9995	1.0000	0.0001T	0.0016T	
	Mount, Engine, Rear Assembly	0.9984	0.9994			

TABLE 202, Torque and Stretch

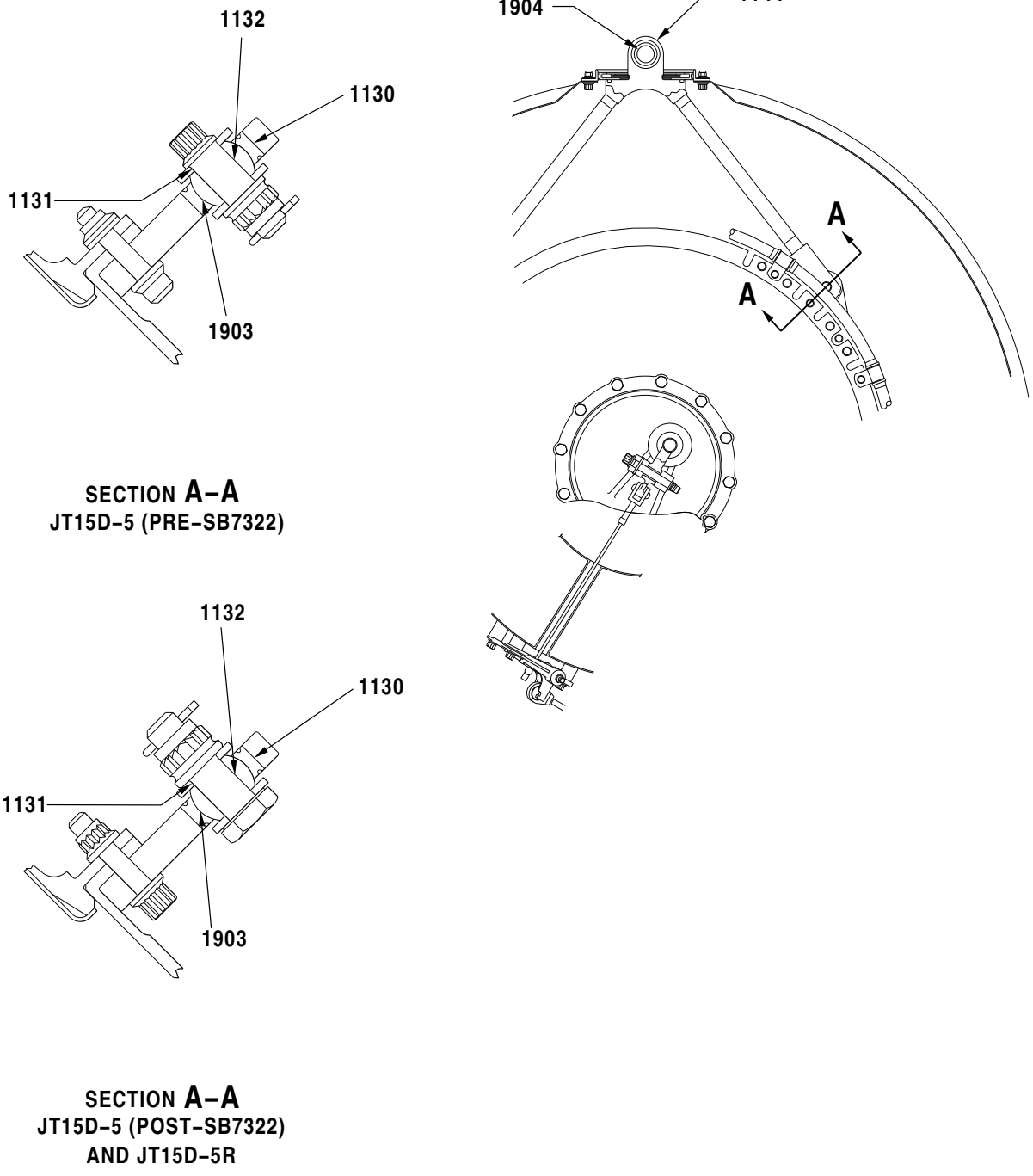
REF. NO.	Name	Limits	
		Min.	Max.
	Not Applicable		

TABLE 203, Spring Pressure

REF. NO.	Name	Limits	
		Min.	Max.
	Not Applicable		

TABLE 204, Special Assembly

REF. NO.	Name	Limits Min.	Limits Max.
1903	JT15D-5 (Pre-SB7438) Engines: Bearing inner ring must move freely under a maximum torque of 30 lb.in.		
1903	JT15D-5 (Post-SB7438) and JT15D-5R Engines: Bearing inner ring must move freely under a maximum torque of 30 lb.in. with axial clearance of 0.006 in. max.		
1904	Bearing inner ring must move freely under a maximum torque of 50 lb.in.		



SECTION A–A
JT15D–5 (PRE–SB7322)

SECTION A–A
JT15D–5 (POST–SB7322)
AND JT15D–5R

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Fits, Clearances and Torque Loadings
Figure 202

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
LEP	1	Oct 06/2006
	2 blank	Oct 06/2006
Contents	1	Oct 06/2006
	2 blank	Oct 06/2006
73-00-00	1	Oct 06/2006
Description and	2	Oct 06/2006
Operation	3	Oct 06/2006
	4	Oct 06/2006
	5	Oct 06/2006
	6	Oct 06/2006
	7	Oct 06/2006
	8	Oct 06/2006
73-00-00	101	Oct 22/99
Fault Isolation	102 blank	Oct 22/99

TABLE OF CONTENTS

SUBJECT	PAGE
ENGINE FUEL AND CONTROL - DESCRIPTION AND OPERATION	**73-00-00**
1. Description	1
A. Components (Fuel)	1
B. Components (Control)	3
C. Operation (General)	3
D. JT15D-5R Fuel De-Icing System	3
ENGINE FUEL AND CONTROL - FAULT ISOLATION	**73-00-00**
1. Engine Fuel and Control - Fault Isolation	101

ENGINE FUEL AND CONTROL - DESCRIPTION AND OPERATION

1. Description (Ref. Figs. 1, 2 and 3)

   A. Components (Fuel)

   The basic fuel system is comprised of the following units:

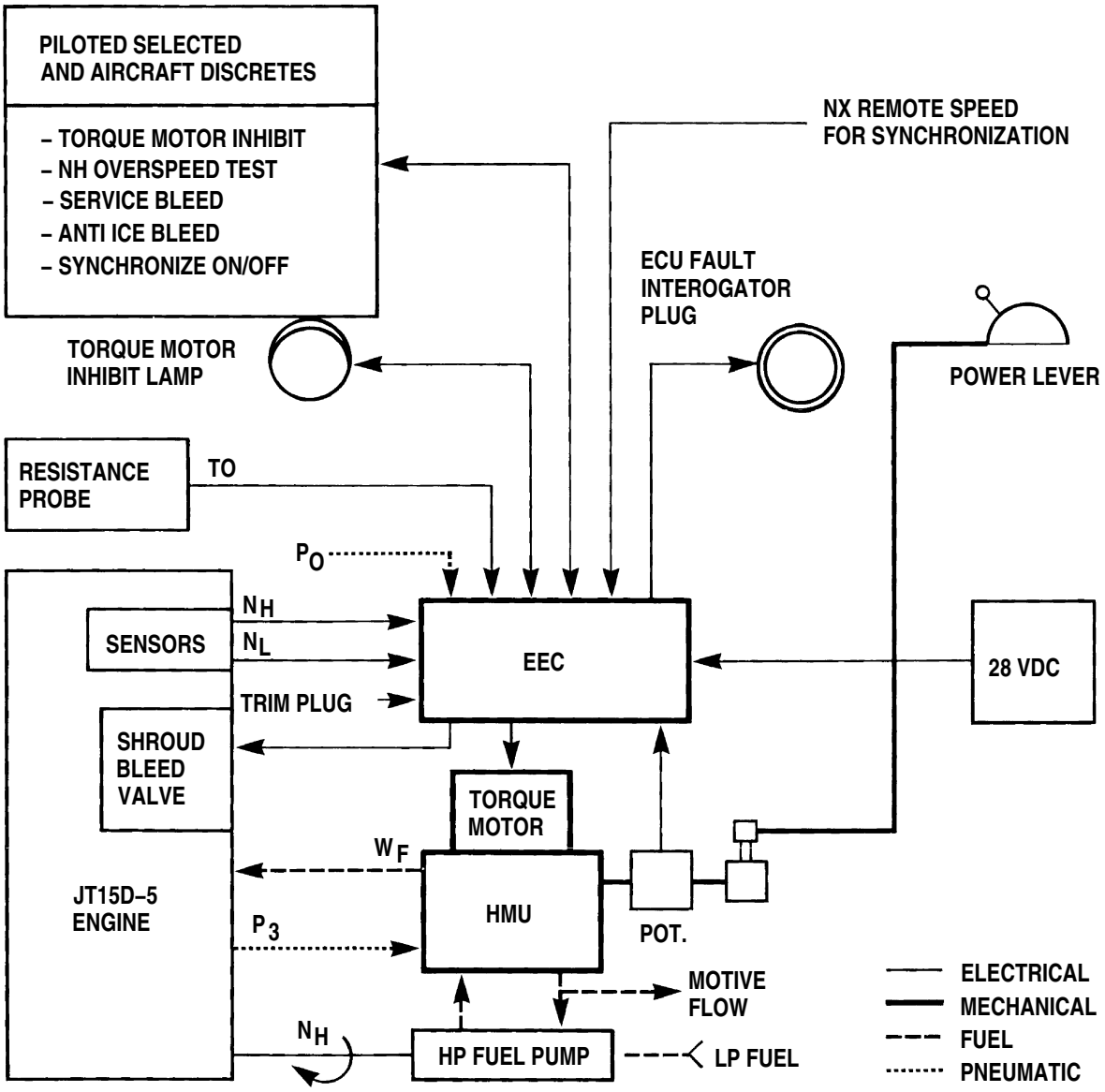
Engine-driven Fuel Pump	Mounted on AGB
Hydromechanical Metering Unit (HMU)	Mounted on fuel pump
Flow Divider Valve	Mounted at 6 o'clock position on outer bypass duct
Fuel-to-oil Cooler	Lower RH side of intermediate case
Emergency Fuel Shutoff Valve	At No. 4 bearing housing
Dual Fuel Manifold	12 dual fuel delivery fuel nozzles mounted on LPT stator support
JT15D-5R Engines Only:	
Fuel/Oil Heat Exchanger (FOHE)	Installed on oil filter housing
Thermostatic Bypass Valve (TBV)	Installed in oil filter housing
Over-Temperature Indicator	Installed on the fuel pump
40 Micron Fuel Filter	Mounted on front of engine
Fuel Filter Impending Bypass Switch	Installed on the 40 micron fuel filter

   For both JT15D-5 and JT15D-5R engines:

   Provision is made for installation of an airframe-supplied fuel flowmeter in the metered fuel line between the HMU and oil cooler.

   Fuel shut-off is provided by the HMU power lever.

   A drain hole in the LPT stator support assembly and two outlet bosses on the gas generator connect via a drain valve located on the outer bypass duct. These, together with a fuel drain located at the rear inner bypass duct, ensure drainage of residual fuel after engine shutdown or an aborted wetstart.



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Engine Fuel Flow System Schematic
Figure 1

B. Components (Control)

The control system is comprised of the following components:

Engine Electronic Control (EEC)	Located at 1 o'clock position on LP compressor case.
Engine Wiring Harness	Externally mounted around engine LH side at flange B. Interconnects EEC, HMU, anti-icing valve, sensors and airframe.

C. Operation (General)

The engine-driven fuel pump supplies high pressure fuel to the HMU in which is packaged a fuel flow metering network together with electromechanical interfaces consisting of a torque motor and power lever potentiometer. The power lever potentiometer translates power lever angular movement into an electrical signal to the EEC, while the torque motor (electrically connected to the EEC) operates a flapper valve in series with an orifice. Thus, for any fuel flow set by the power lever angle, except at engine start and shut-off, the EEC computes other control parameters to trim that scheduled flow to its optimum value at all altitudes and temperatures.

Power lever overtravel beyond normal maximum thrust position is provided to ensure adequate thrust in the event of EEC shutdown.

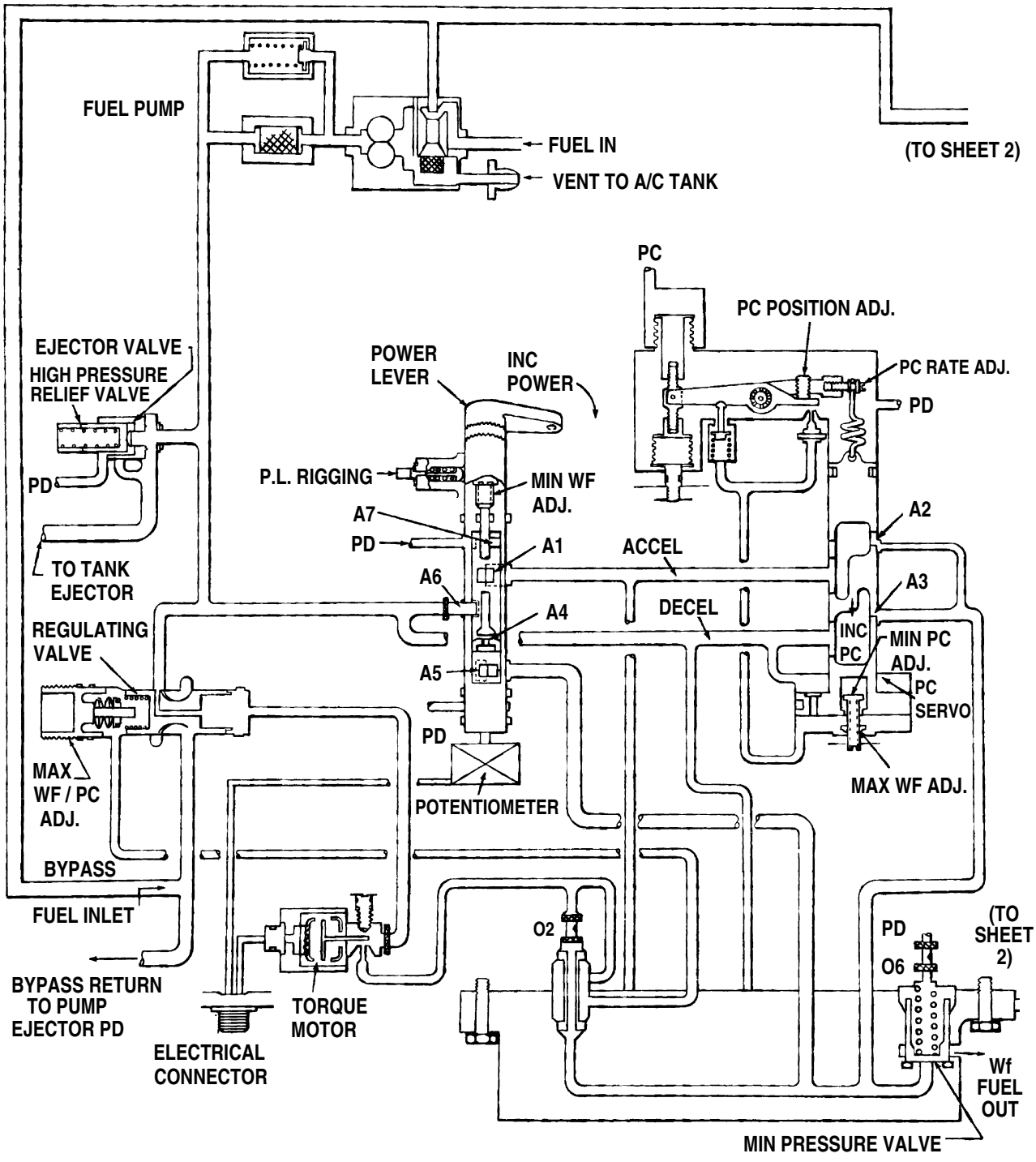
For further detailed description and operation of individual fuel control system components, refer to the relevant sections in this Chapter.

D. JT15D-5R Fuel De-Icing System

The engine driven-fuel pump on the JT15D-5R has two additional ports after the centrifugal pump stage. The fuel inlet pressure is boosted by the centrigugal stage of the pump. This low pressure fuel is sent to a fuel/oil heat exchanger (FOHE). Engine oil is used to heat the fuel. A thermostatic bypass valve (TBV) controls the flow of oil through the FOHE.

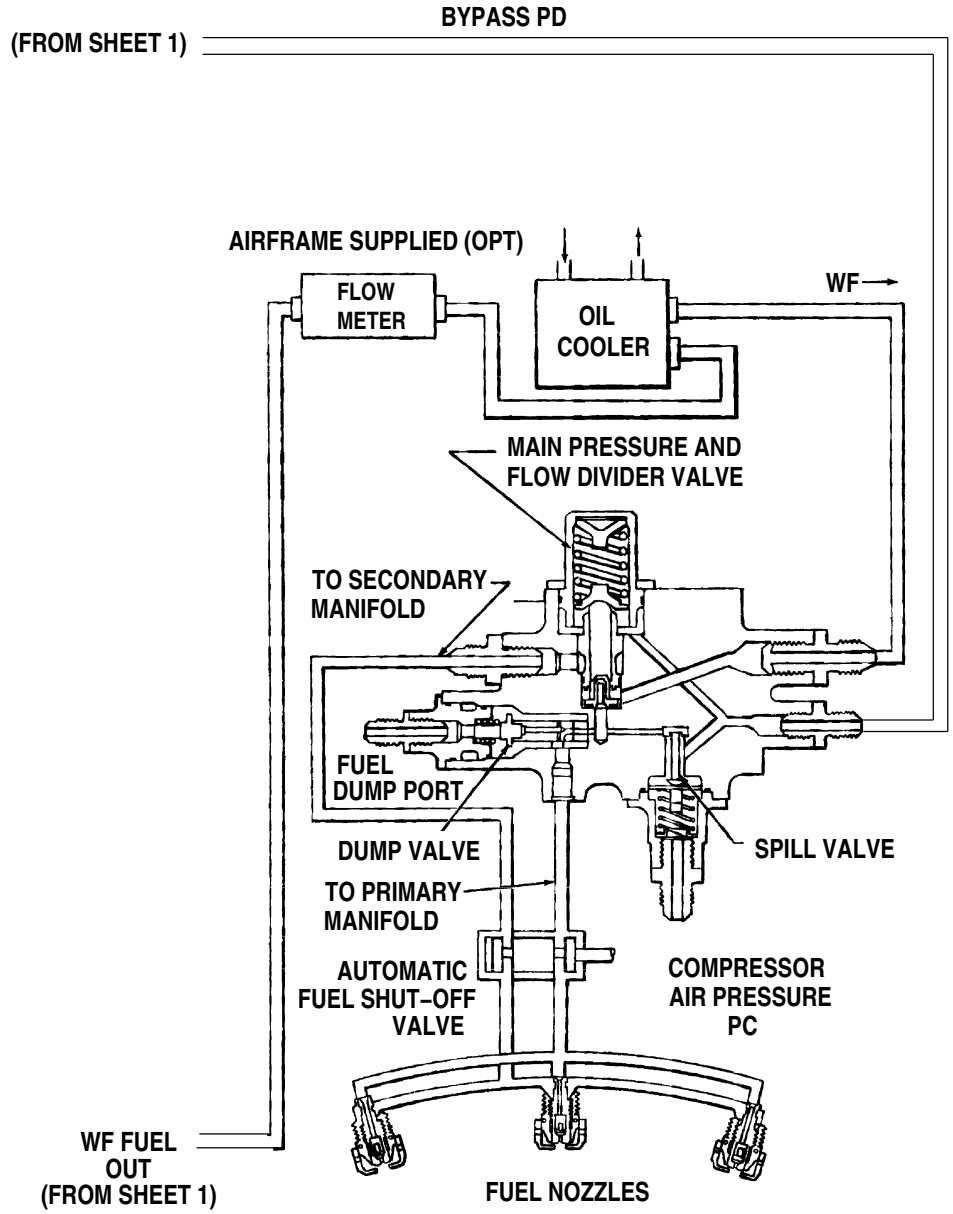
After the fuel is heated it goes to a 40 micron self-bypassing fuel filter. The bypass valve opens when there is a differential pressure of 3.7 psid between the fuel inlet and outlet. The fuel then bypasses the filter and goes directly to the outlet. The bypass valve closes when the pressure drops to 3.0 psid. An impending bypass switch is mounted on the housing. The impending bypass switch closes when the differential pressure increases to 2.5 ±0.5 psid. It is connected to an airframe harness to give a signal to the flight crew of an impending bypass condition. The filter housing has a disposible filter element. The filter housing is mounted on the front of the engine. It can be mounted on either the left or right side depending on the engine installation requirements.

The fuel is then sent to the thermal element of the TBV. The thermal element controls the flow of oil to the FOHE. When the fuel temperature reaches a preset value, the thermal element causes the valve to bypass the FOHE. When the temperature decreases the thermal element restores oil flow to the FOHE.



JT15D-5 Only C109041

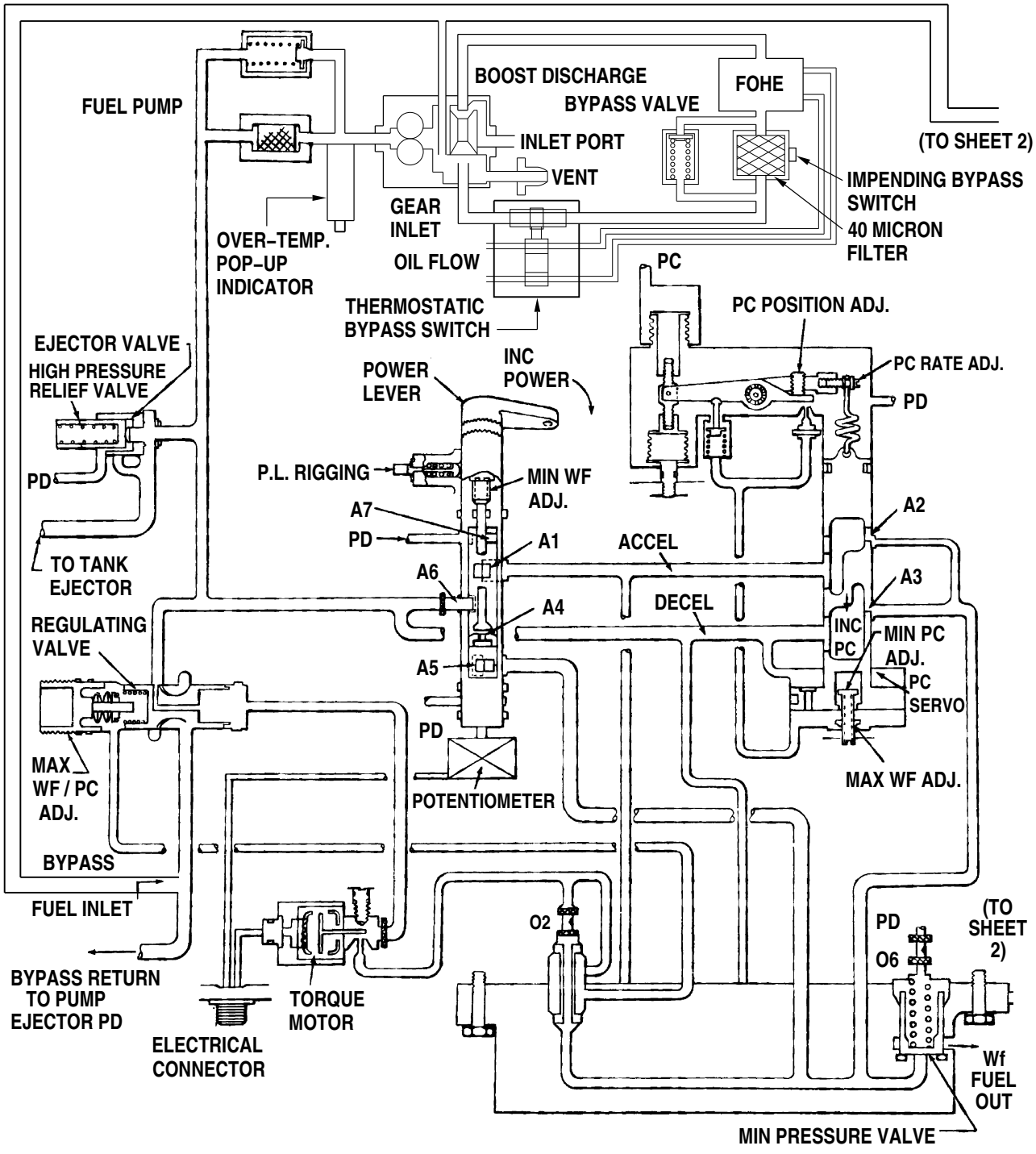
JT15D-5 Engine Fuel Control System Schematic
Figure 2 (Sheet 1 of 2)



JT15D-5 Only

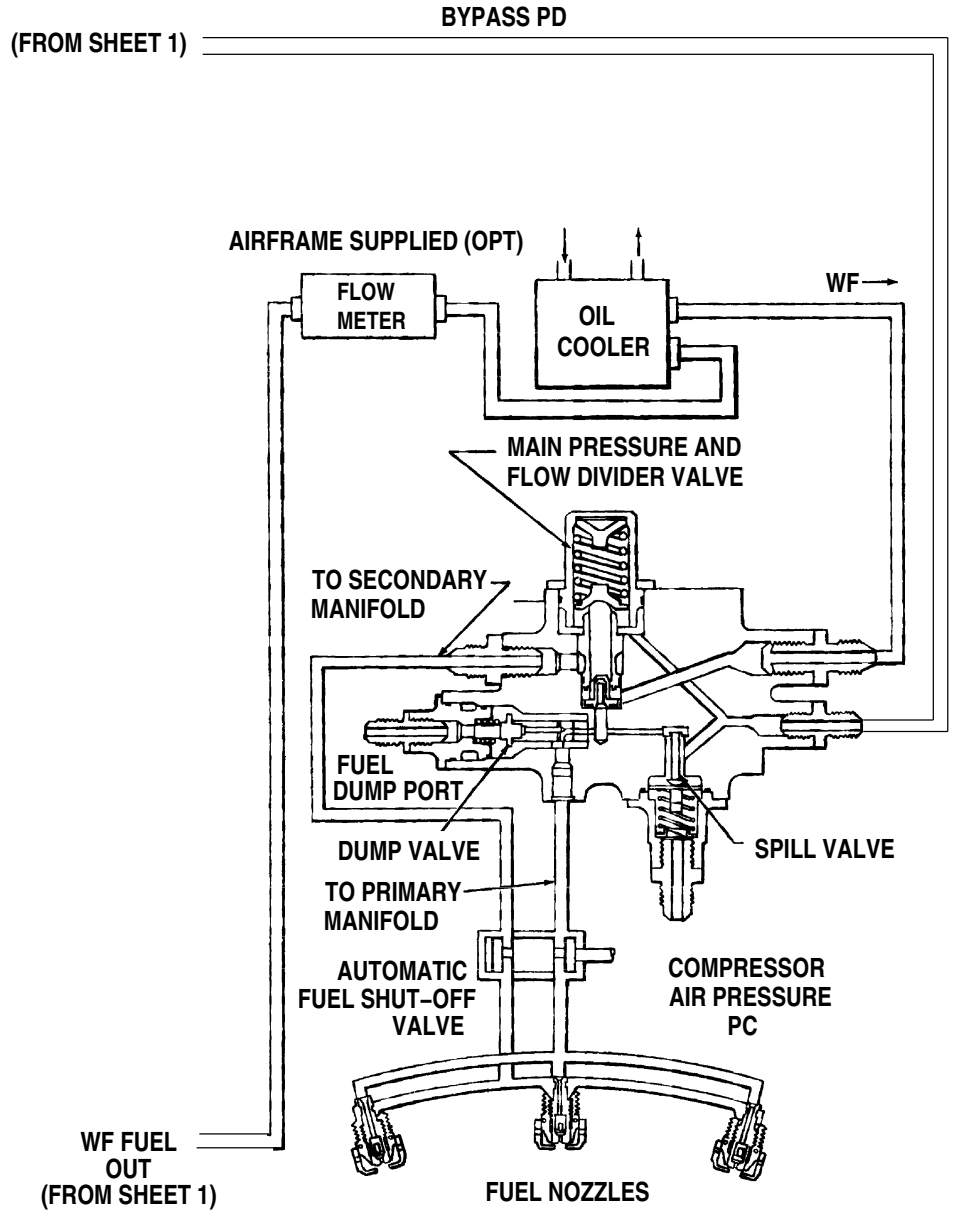
C109042

JT15D-5 Engine Fuel Control System Schematic
Figure 2 (Sheet 2)



JT15D-5R Only C109043

JT15D-5R Engine Fuel Control System Schematic
Figure 3 (Sheet 1 of 2)



JT15D-5R Only

C109044

JT15D-5R Engine Fuel Control System Schematic
Figure 3 (Sheet 2)

The heated and filtered fuel returns to the fuel pump through the gear inlet port. The gear stage of the pump pressurizes the fuel. An over-temperature pop-up indicator mounted on the fuel pump gives a visual indication if the pressurized fuel is too hot (184 ±9°F). The indicator must be manually reset.

ENGINE FUEL AND CONTROL - FAULT ISOLATION

1. Engine Fuel and Control - Fault Isolation

For detailed fault isolation procedures on engine systems, refer to Chapter 72-00-00, FAULT ISOLATION, Tables 1 and 2.

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
LEP	1	May 13/2013
	2	May 13/2013
	3	May 13/2013
	4 blank	May 13/2013
Contents	1	May 13/2013
	2	May 13/2013
	3	May 13/2013
	4	May 13/2013
	5	May 13/2013
	6	May 13/2013
	7	May 13/2013
	8	May 13/2013
	9	May 13/2013
	10 blank	May 13/2013
73-10-01	1	Oct 06/2006
Description and	2	Oct 06/2006
Operation	3	Oct 06/2006
	4 blank	Oct 06/2006
73-10-01	201	May 13/2013
Maintenance	202	May 13/2013
Practices	203	May 13/2013
	204	May 13/2013
	205	May 13/2013
	206	May 13/2013
	207	May 13/2013
	208	May 13/2013
	209	May 13/2013
	210	May 13/2013
	211	May 13/2013
	212	May 13/2013
	213	May 13/2013
	214	May 13/2013
	215	May 13/2013
	216	May 13/2013
	217	May 13/2013
	218	May 13/2013
	219	May 13/2013
	220	May 13/2013
	221	May 13/2013
	222 blank	May 13/2013
73-10-02	1	Oct 06/2006
Description and	2	Oct 06/2006
Operation	3	Oct 06/2006
	4	Oct 06/2006
73-10-02	201	Oct 06/2006
Maintenance	202	Oct 06/2006
Practices	203	Oct 06/2006
	204	Oct 06/2006
	205	Oct 06/2006
	206	Oct 06/2006
	207	Oct 06/2006
	208	Oct 06/2006
	209	Oct 06/2006
	210	Oct 06/2006
	211	Oct 06/2006
	212 blank	Oct 06/2006
73-10-03	1	Oct 22/99
Description and	2 blank	Oct 22/99
Operation		
73-10-03	201	Oct 06/2006
Maintenance	202	Oct 06/2006
Practices	203	Oct 06/2006
	204	Oct 06/2006
	205	Oct 06/2006
	206	Oct 06/2006
73-10-04	1	Oct 22/99
Description and	2	Oct 22/99
Operation		
73-10-04	201	Oct 06/2006
Maintenance	202	Oct 06/2006
Practices	203	Oct 06/2006
	204	Oct 06/2006
	205	Oct 06/2006

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
	206 blank	Oct 06/2006
73-10-05	1	Oct 06/2006
Description and	2	Oct 06/2006
Operation	3	Oct 06/2006
	4	Oct 06/2006
	5	Oct 06/2006
	6	Oct 06/2006
73-10-05	201	May 13/2013
Maintenance	202	May 13/2013
Practices	203	May 13/2013
	204	May 13/2013
	205	May 13/2013
	206	May 13/2013
	207	May 13/2013
	208	May 13/2013
	209	May 13/2013
	210	May 13/2013
	211	May 13/2013
	212	May 13/2013
	213	May 13/2013
	214	May 13/2013
	215	May 13/2013
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	217	May 13/2013
	218	May 13/2013
	219	May 13/2013
	220	May 13/2013
	221	May 13/2013
	222	May 13/2013
	223	May 13/2013
	224	May 13/2013
	225	May 13/2013
	226 blank	May 13/2013
73-10-06	1	Oct 22/99
Description and	2 blank	Oct 22/99
Operation		
73-10-06	201	Oct 06/2006
Maintenance	202	Oct 06/2006
Practices	203	Oct 06/2006
	204 blank	Oct 06/2006
73-10-07	1	Oct 06/2006
Description and	2	Oct 06/2006
Operation		
73-10-07	201	Oct 22/99
Maintenance	202 blank	Oct 22/99
Practices		
73-10-09	1	Oct 22/99
Description and	2 blank	Oct 22/99
Operation		
73-10-09	201	Oct 06/2006
Maintenance	202	Oct 06/2006
Practices	203	Oct 06/2006
	204	Oct 06/2006
	205	Oct 06/2006
	206 blank	Oct 06/2006
73-10-10	1	Oct 22/99
Description and	2 blank	Oct 22/99
Operation		
73-10-10	201	Oct 06/2006
Maintenance	202	Oct 06/2006
Practices	203	Oct 06/2006
	204	Oct 06/2006
	205	Oct 06/2006
	206	Oct 06/2006
	207	Oct 06/2006
	208	Oct 06/2006
73-10-11	1	Oct 22/99
Description and	2	Oct 22/99
Operation	3	Oct 22/99
	4	Oct 22/99

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
	5	Oct 22/99
	6 blank	Oct 22/99
73-10-11 Maintenance Practices	201	Oct 22/99
	202	Oct 22/99
	203	Oct 22/99
	204	Oct 22/99
	205	Oct 22/99
	206	Oct 22/99
	207	Oct 22/99
	208 blank	Oct 22/99
73-10-12 Description and Operation	1	Oct 06/2006
	2	Oct 06/2006
73-10-12 Maintenance Practices	201	Oct 22/99
	202 blank	Oct 22/99
73-10-13 Description and Operation	1	Oct 06/2006
	2	Oct 06/2006
73-10-13 Maintenance Practices	201	Oct 06/2006
	202	Oct 06/2006
	203	Oct 06/2006
	204	Oct 06/2006
	205	Oct 06/2006
	206	Oct 06/2006
	207	Oct 06/2006
	208	Oct 06/2006
	209	Oct 06/2006
	210 blank	Oct 06/2006
73-10-14 Description and Operation	1	Oct 06/2006
	2	Oct 06/2006
73-10-14 Maintenance Practices	201	Oct 06/2006
	202	Oct 06/2006
	203	Oct 06/2006
	204	Oct 06/2006
	205	Oct 06/2006
	206	Oct 06/2006
	207	Oct 06/2006
	208 blank	Oct 06/2006

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
FUEL-TO-OIL COOLER AND FUEL TUBES - DESCRIPTION AND OPERATION	**73-10-01**
1. Fuel-to-Oil Cooler	1
2. JT15D-5R Fuel Tubes	1
FUEL-TO-OIL COOLER - MAINTENANCE PRACTICES	**73-10-01**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal of the JT15D-5 Oil Cooler	201
B. Removal of the JT15D-5R Oil Cooler	201
C. Installation of the JT15D-5 Oil Cooler	203
D. Installation of the JT15D-5R Oil Cooler	205
E. Removal of the JT15D-5 Pressure Fuel Tubes (HMU-to-Oil Cooler-to FDV)	205
F. Removal of the JT15D-5R Fuel Filter Fuel Tubes	208
G. Removal of the JT15D-5R Oil Cooler Fuel Tubes	208
H. Removal of the JT15D-5R Fuel Pump Fuel Tubes	213
I. Installation of the JT15D-5 Pressure Fuel Tubes (HMU-to-Oil Cooler-to FDV)	215
J. Installation of the JT15D-5R Fuel Pump Fuel Tubes	216
K. Installation of the JT15D-5R Oil Cooler Fuel Tubes	217
L. Installation of the JT15D-5R Fuel Filter Fuel Tubes	219
6. Adjustment/Test	220
A. Oil Cooler - Oil Flow Check and Pressure Check	220
7. Inspection/Check	220

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
FUEL-TO-OIL COOLER - MAINTENANCE PRACTICES (Cont'd)	**73-10-01**
A. Oil Cooler	220
B. Pressure Fuel Tubes	221
8. Cleaning/Painting	221
A. Pressure Fuel Tubes	221
FUEL PUMP - DESCRIPTION AND OPERATION	**73-10-02**
1. Fuel Pump	1
2. Operation	1
FUEL PUMP - MAINTENANCE PRACTICES	**73-10-02**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Servicing	201
A. Removal of Filters	201
B. Cleaning and Inspection	201
C. Installation of Filters	205
6. Removal/Installation	205
A. Removal of Fuel Pump	205
B. Installation of Fuel Pump	209
C. Removal of the Overtemperature Popup Indicator (JT15D-5R)	209
D. Installation of the Overtemperature Popup Indicator (JT15D-5R)	209
7. Inspection/Check	211
A. Procedure	211
8. Adjustment/Test	211

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
FUEL PUMP - MAINTENANCE PRACTICES (Cont'd)	**73-10-02**
9. Cleaning/Painting	211
A. Procedure	211
FUEL TUBES, FDV TO FUEL MANIFOLD - DESCRIPTION AND OPERATION	**73-10-03**
1. Manifold Pressure Fuel Tubes	1
FUEL TUBES, FDV TO FUEL MANIFOLD - MAINTENANCE PRACTICES	**73-10-03**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation (Heavy Maintenance Only)	201
A. Removal of Primary and Secondary Pressure Fuel Transfer Tubes	201
B. Installation of Primary and Secondary Pressure Fuel Transfer Tubes	201
6. Inspection/Check	204
A. Inspect fuel pressure tube as follows:	204
7. Cleaning/Painting	204
A. Clean pressure fuel tube as follows:	204
8. Fits, Clearances and Torque Loadings	204
FLOW DIVIDER VALVE - DESCRIPTION AND OPERATION	**73-10-04**
1. Flow Divider Valve)	1
FLOW DIVIDER VALVE - MAINTENANCE PRACTICES	**73-10-04**
1. General	201
2. Consumable Materials	201
3. Special Tools	201

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
FLOW DIVIDER VALVE - MAINTENANCE PRACTICES (Cont'd)	**73-10-04**
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal of Flow Divider Valve (FDV)	201
B. Installation of Flow Divider Valve	201
FUEL MANIFOLD ASSEMBLY - DESCRIPTION AND OPERATION	**73-10-05**
1. Description	1
A. Fuel Manifold	1
B. Fuel Manifold Adapter Assemblies	1
C. Fuel Nozzles	1
2. Operation	3
FUEL MANIFOLD ASSEMBLY - MAINTENANCE PRACTICES	**73-10-05**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	202
A. Removal of Fuel Manifold Assembly	202
B. Installation of Fuel Manifold Assembly	207
6. Adjustment/Test	208
A. General	208
B. Functional Test of Fuel Manifold Nozzle Adapters	209
C. JT15D-5 (Pre-SB7598) Fuel Manifold Leak Test using PWC30186 Test Rig	215
D. Fuel Manifold Leak Test for JT15D-5 (Post-SB7598) and JT15D-5R Nozzle Adapter Assemblies	215
7. Inspection/Check	217

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The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
FUEL MANIFOLD ASSEMBLY - MAINTENANCE PRACTICES (Cont'd)	**73-10-05**
A. Fuel Nozzle Assembly	217
8. Cleaning/Painting	217
A. Fuel Nozzle Assemblies:	217
9. Approved Repairs	218
A. Fuel Manifold Inlet and Automatic Fuel Shut-off Valve Assembly - Repair by Replacement	218
B. Fuel Manifold Adapter Assemblies	219
10. Fits, Clearances and Torque Loadings	223
FUEL DRAIN VALVE - DESCRIPTION AND OPERATION	**73-10-06**
1. Fuel Drain Valve	1
FUEL DRAIN VALVE - MAINTENANCE PRACTICES	**73-10-06**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal of Gas Generator Case Fuel Drain Valve	201
B. Installation of Gas Generator Case Fuel Drain Valve	201
C. Exhaust Area Fuel Drain	203
FUEL FLOWMETER INSTALLATION - DESCRIPTION AND OPERATION	**73-10-07**
1. Fuel Flowmeter	1
FUEL FLOWMETER INSTALLATION - MAINTENANCE PRACTICES	**73-10-07**
1. Removal/Installation	201

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
FUEL PRESSURE AND BYPASS TUBES - DESCRIPTION AND OPERATION	**73-10-09**
1. External Pressure and Bypass Fuel Tubes	1
FUEL PRESSURE AND BYPASS TUBES - MAINTENANCE PRACTICES	**73-10-09**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal of Primary and Secondary Pressure Fuel Tubes and Bypass Tube	201
B. Installation of Primary and Secondary Pressure Fuel Tubes and Bypass Tube	201
6. Inspection/Check	205
A. Fuel Tubes	205
7. Cleaning/Painting	205
A. Pressure Fuel Tubes	205
HP COMPRESSOR AIR DELIVERY TUBES - DESCRIPTION AND OPERATION	**73-10-10**
1. Compressor Discharge Air Tube	1
HP COMPRESSOR AIR DELIVERY TUBES - MAINTENANCE PRACTICES	**73-10-10**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
HP COMPRESSOR AIR DELIVERY TUBES - MAINTENANCE PRACTICES (Cont'd)	**73-10-10**
A. Removal of the JT15D-5 Pneumatic (P3) Tubes	201
B. Removal of the JT15D-5R Pneumatic (P3) Tubes	201
C. Installation of the JT15D-5 Pneumatic (P3) Tubes	203
D. Installation of the JT15D-5R Pneumatic (P3) Tubes	203
6. Inspection/Check	207
A. Pneumatic Tubes	207
7. Cleaning/Painting	208
A. Pneumatic Tubes	208
EMERGENCY FUEL SHUTOFF SYSTEM - DESCRIPTION AND OPERATION	**73-10-11**
1. General and 2)	1
2. Emergency Fuel Shutoff System)	1
EMERGENCY FUEL SHUTOFF - MAINTENANCE PRACTICES	**73-10-11**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation (Heavy Maintenance Only)	201
A. Removal of Emergency Fuel Shutoff Control Linkage).	201
B. Installation of Emergency Fuel Shutoff Control Linkage)	201
C. Removal/Resetting/Installation of Overspeed Control Linkage Housing (Tripper))	206
D. Resetting Overspeed Control Linkage Housing (Tripper)	206
E. Installation of Overspeed Control Linkage Housing (Tripper)	207
F. Removal/Installation of Emergency Fuel Shutoff Valve	207

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
EMERGENCY FUEL SHUTOFF - MAINTENANCE PRACTICES (Cont'd)	**73-10-11**
6. Adjustment/Test	207
7. Inspection/Check	207
8. Approved Repairs	207
BLEED VALVE ACTUATOR - DESCRIPTION AND OPERATION	**73-10-12**
1. Bleed Valve Actuator	1
A. Description	1
B. Operation	1
BLEED VALVE ACTUATOR - MAINTENANCE PRACTICES	**73-10-12**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal	201
B. Installation	201
FUEL FILTER AND IMPENDING BYPASS SWITCH - DESCRIPTION AND OPERATION	**73-10-13**
1. Fuel Filter and Impending Bypass Switch (JT15D-5R Engines)	1
FUEL FILTER AND IMPENDING BYPASS SWITCH (JT15D-5R) - MAINTENANCE PRACTICES	**73-10-13**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201

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The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
FUEL FILTER AND IMPENDING BYPASS SWITCH (JT15D-5R) - MAINTENANCE PRACTICES (Cont'd)	**73-10-13**
A. Removal of the Fuel Filter	201
B. Installation of the Fuel Filter	205
C. Removal of the Impending Bypass Switch	205
D. Installation of the Impending Bypass Switch	207
E. Removal of the Fuel Filter Element	207
F. Installation of the Fuel Filter Element	208
6. Inspection/Check	208
A. Fuel Filter Element	208
FUEL/OIL HEAT EXCHANGER (JT15D-5R) - DESCRIPTION AND OPERATION	**73-10-14**
1. Fuel/Oil Heat Exchanger (FOHE)	1
FUEL/OIL HEAT EXCHANGER (JT15D-5R) - MAINTENANCE PRACTICES	**73-10-14**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal of Fuel/Oil Heat Exchanger (FOHE)	201
B. Installation of Fuel/Oil Heat Exchanger (FOHE)	203
C. Removal of the FOHE Heat Shield	204
D. Installation of the FOHE Heat Shield	204

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The export control classification with respect to this document is contained on the back of the title page.

FUEL-TO-OIL COOLER AND FUEL TUBES - DESCRIPTION AND OPERATION

1. Fuel-to-Oil Cooler (Ref. Fig. 1)

The oil cooler is secured to the oil filter and relief valve housing located on the intermediate case at the right-hand lower side of the engine. The cooler is essentially an oil-to-fuel heat exchanger and is considered adequate to handle all the cooling requirements of the engine which has two hot bearing areas : No. 3 and No. 3-½ which constitute one area, and No. 4 bearing area. For this reason it is not necessary to install an oil cooler in the airframe.

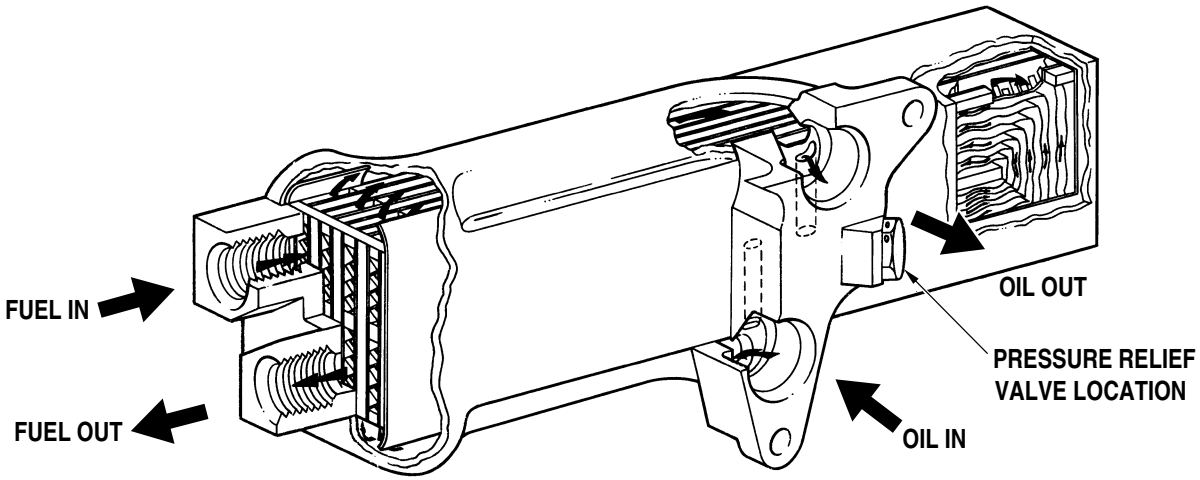
The oil cooler consists of an assembly of passages for oil flow surrounding a separate fuel flow chamber core. For JT15D-5 (Pre-SB7412) engines, the oil/fuel heat exchanger body and the ported shell which encloses it, are made of aluminum. All external surfaces except mounting flanges are anodized, coated with a primer and epoxy enamel. In addition, a fire-resistant material (intumescent paint) is applied. For JT15D-5 (Post-SB7412) and JT15D-5R engines, the oil/fuel heat exchanger body and the ported shell are made of stainless steel.

Hot engine oil is channelled through passages surrounding the fuel chamber core. Pressure fuel from the HMU circulates through a matrix of tubes within the core and absorbs heat from the engine oil through the core walls. During the heat exchange, engine oil is cooled before it is distributed to the engine bearings and the AGB.

2. JT15D-5R Fuel Tubes (Ref. Fig. 2)

The fuel tubes transfer the low pressure fuel from the centrifugal stage of the fuel pump to the Fuel/Oil Heat Exchanger (FOHE) and then to the 40 micron fuel filter. Tubes then transfer the heated and filtered fuel through the thermostatic bypass valve (located in the oil filter housing) back to the inlet of the gear stage of the fuel pump.

The gear stage of the fuel pump pressurizes the fuel and transfer the it through the bleed valve actuator to the hydromechanical metering unit. The high pressure, metered fuel is transferred through tubes to flowmeter and on to the oil cooler. Tubes then transfer the fuel to the flow divider valve.



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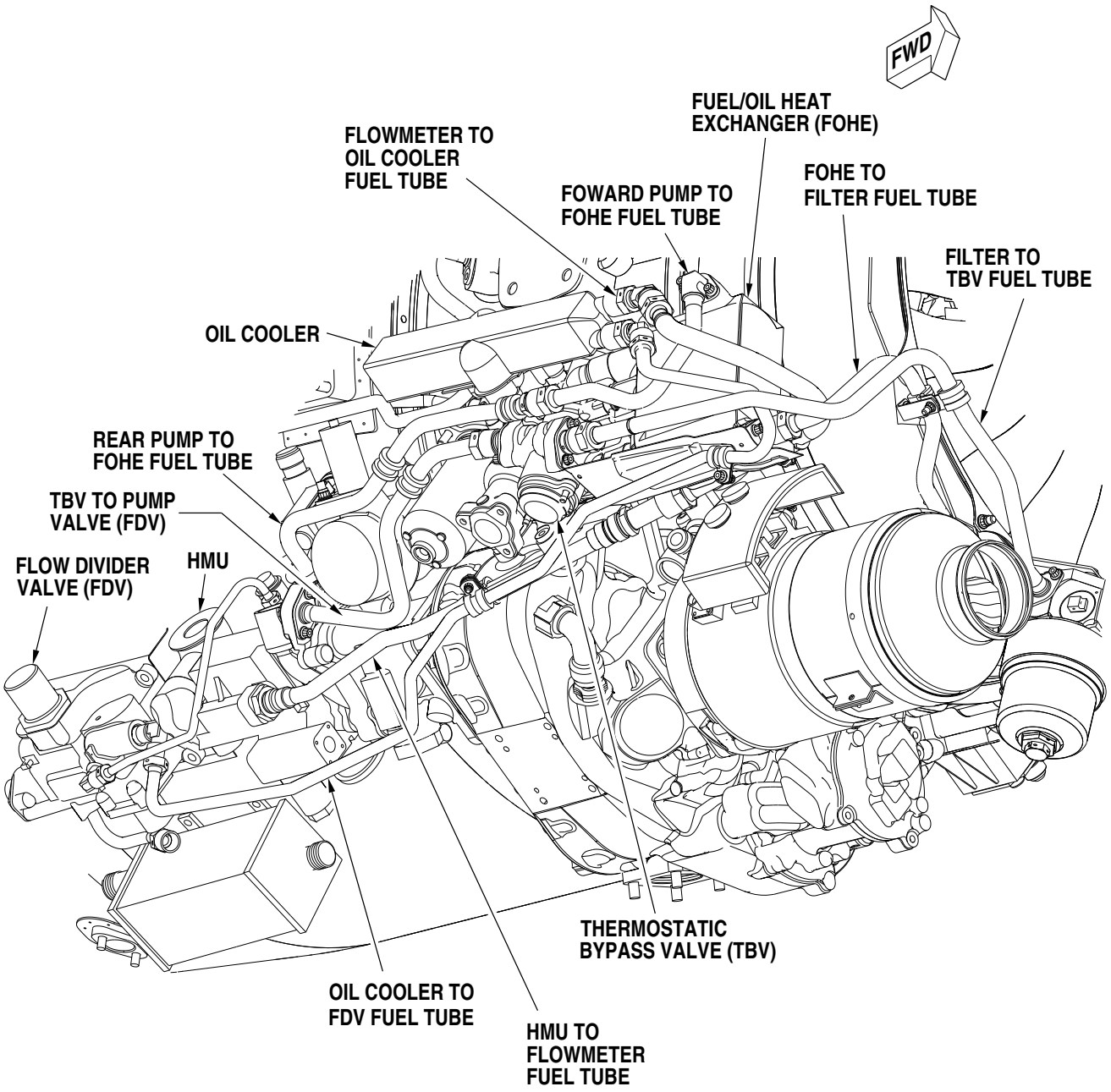
Oil Cooler Flow Diagram
Figure 1


FWD
FUEL/OIL HEAT EXCHANGER (FOHE)
FLOWMETER TO OIL COOLER FUEL TUBE
FOWARD PUMP TO FOHE FUEL TUBE
FOHE TO FILTER FUEL TUBE
FILTER TO TBV FUEL TUBE
OIL COOLER
REAR PUMP TO FOHE FUEL TUBE
TBV TO PUMP VALVE (FDV)
FLOW DIVIDER VALVE (FDV)
HMU
THERMOSTATIC BYPASS VALVE (TBV)
OIL COOLER TO FDV FUEL TUBE
HMU TO FLOWMETER FUEL TUBE

C109040

JT15D-5R Fuel Tubes - Component Location
Figure 2

FUEL-TO-OIL COOLER - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the oil cooler and associated fuel pressure tubes.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Engine Lubricating Oil
PWC05-050	Nitrogen Gas
PWC06-009	Anti-Seize Compound
PWC11-027	Petroleum Solvent

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal of the JT15D-5 Oil Cooler (Ref. Fig. 201)

      (1) Remove lockwire and disconnect fuel tubes (7) and (10) or (1) from cooler (8).

      (2) Remove two straight nipples (2) (BS636 installation) or one straight nipple (2) and one reducer (9) (BS657, BS713, and BS1191 installations) with preformed packings (3) from end of oil cooler (8). Discard preformed packings.

         NOTE: Step (2) is not required if same unit is to be installed.

      (3) Remove three self-locking nuts (4) and one washer (11) securing oil cooler (8).

      (4) Remove oil cooler (8) and transfer tubes (6) from filter housing assembly and remove transfer tubes from oil cooler. Remove and discard preformed packings (5) from each end of transfer tubes (6).

   B. Removal of the JT15D-5R Oil Cooler (Ref. Fig. 202)

      (1) Remove the fuel tubes (10) and (1). Refer to para. 5.G.

      (2) Remove the three self-locking nuts (7) and one washer (8) that attach the oil cooler (9) to the oil filter housing (12).

      (3) Remove the oil cooler (9) and transfer tubes (6) from the oil filter housing (12).

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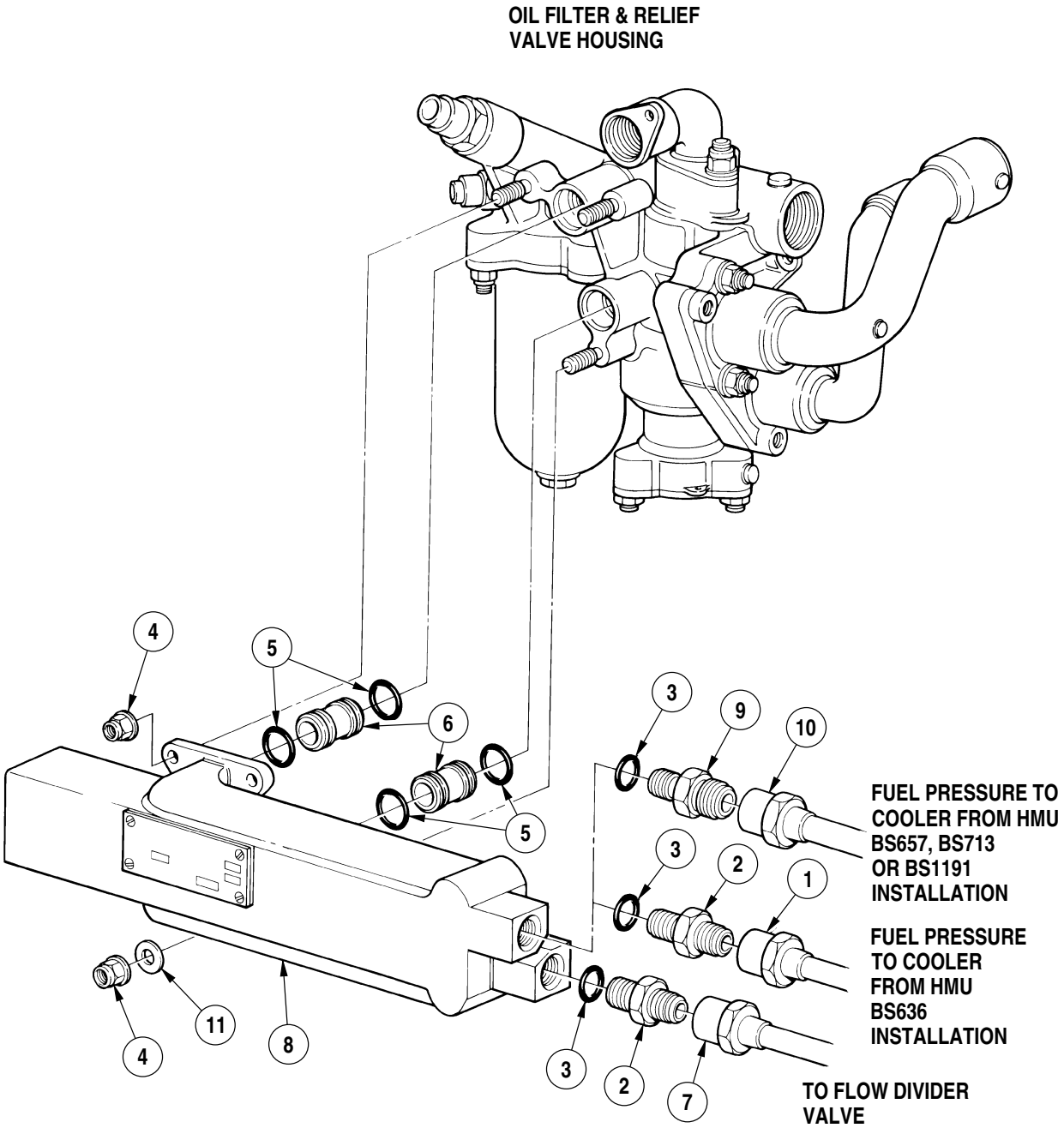

JT15D-5 Only C19999B

Removal/Installation - Oil Cooler
Figure 201

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Key to Figure 201

1. Fuel Tube from FCU
2. Straight Nipple
3. Preformed Packing
4. Self-locking Nut
5. Preformed Packing
6. Transfer Tube
7. Fuel Tube to Flow Divider Valve (BS636 installation)
8. Oil Cooler
9. Reducer (BS657, BS713, and BS1191 installations)
10. HMU Fuel Tube (BS657, BS713, and BS1191 installations)
11. Washer

(4) Remove the transfer tubes (6) from the oil cooler (9). Remove and discard the preformed packings (5) from each end of transfer tubes (6).

(5) If the oil cooler (9) is to be replaced, loosen the nuts (2) and remove the tube-to-boss elbows (3) and (4), nuts (2), back-up ring (13), and packings (11). Discard the packings (11).

(6) Put protective caps and covers in all openings.

(7) Refer to Subpara. 6., Adjustment/Test.

C. Installation of the JT15D-5 Oil Cooler (Ref. Fig. 201)

(1) Install preformed packings (5) on each end of transfer tubes (6) and insert tubes into oil filter housing.

(2) Position oil cooler (8) on studs in oil filter housing; ensure transfer tubes (6) enter cooler properly, and secure with one washer (11) mounted on single, lower stud self-locking nuts (4). Tighten and torque nuts to 32 to 36 lb.in.

(3) If previously removed, install preformed packings (3) on straight nipples (2) (BS636 installation) or on straight nipple (2) and one reducer (9) (BS657, BS713, and BS1191 installations). Install nipples or nipple and reducer in cooler (8). Torque nipple and reducer 110 to 120 lb.in. and lockwire.

(4) On BS636 installation, connect fuel tubes (1), (7) to nipples. Tighten and torque coupling nuts to 270 to 300 lb.in. and lockwire. Tighten and torque coupling nuts to coupling tube (5) to 450 to 500 lb.in. and lockwire.

(5) On BS657, BS713, and BS1191 installations, connect fuel tube (7) to straight nipple (2) and fuel tube (10) to reducer (9) . Tighten and torque coupling on tube (1) to 270 to 300 lb.in. and coupling on tube (10) to 450 to 500 lb.in. and lockwire.

(6) Lockwire coupling nuts on pressure fuel tubes (1) or (10) and (7).

(7) Refer to Subpara. 6., Adjustment/Test.

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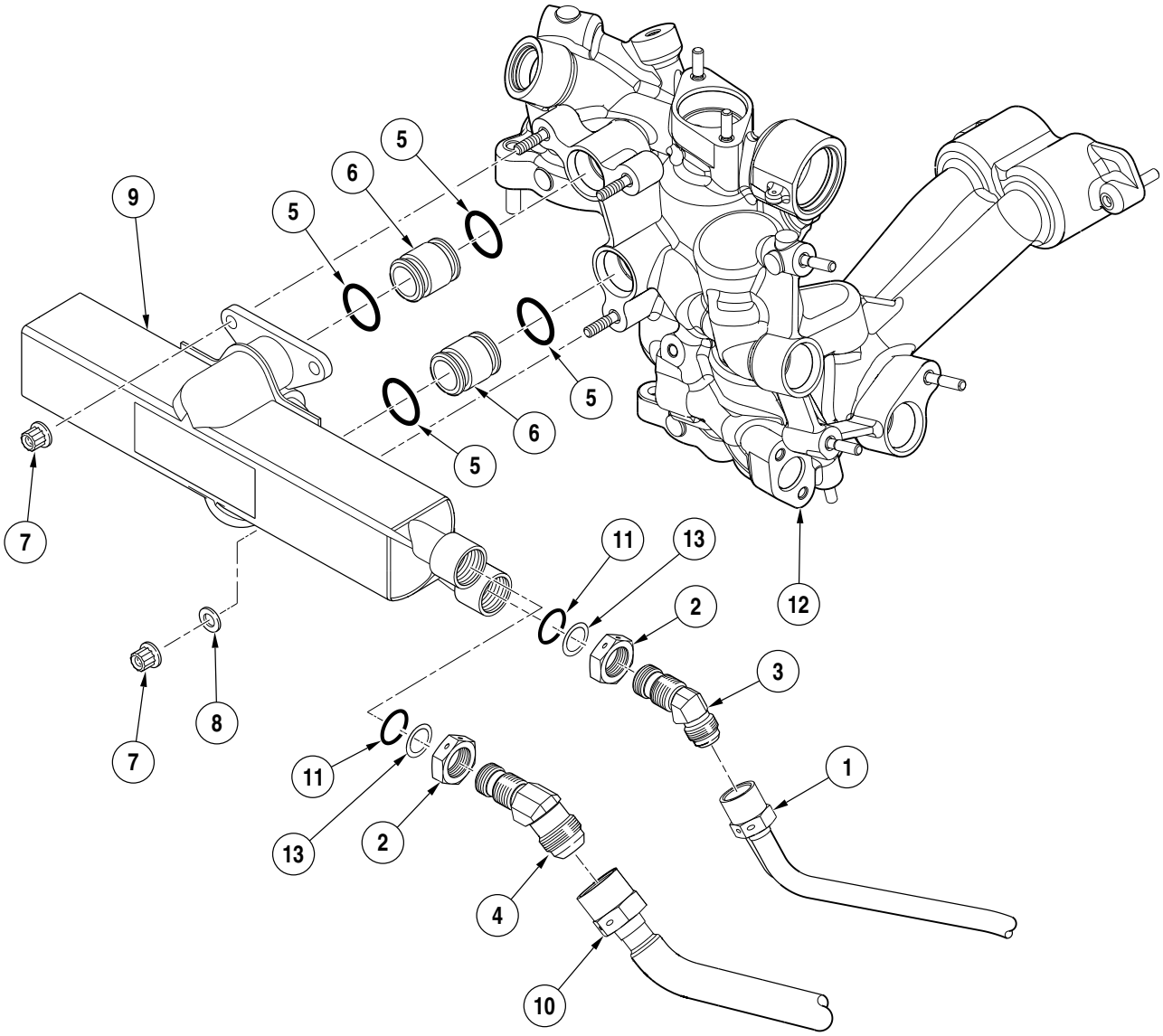

JT15D-5R Only

C108913B

Removal/Installation - Oil Cooler
Figure 202

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Key to Figure 202

1. Flowmeter-to-Oil Cooler Fuel Pressure Tube
2. Hex Nut
3. 60° Tube-to-Boss Elbow
4. 45° Tube-to-Boss Elbow
5. Preformed Packing
6. Transfer Tube
7. Nut
8. Washer
9. Oil Cooler
10. Oil Cooler-to-FDV Fuel Pressure Tube
11. Preformed Packing
12. Oil Filter Housing (Ref. 79-20-01)
13. Back-Up Ring

D. Installation of the JT15D-5R Oil Cooler (Ref. Fig. 202)

(1) Remove the protective caps and covers.

(2) Apply a light film of oil (PWC03-001) to preformed packings (5) and (11).

(3) Install preformed packings (5) on each end of the transfer tubes (6).

(4) Put the transfer tubes (6) in the oil cooler (9).

(5) Align the oil cooler (9) and the transfer tubes (6) with the oil filter housing (12). Make sure the transfer tubes (6) enter the housing properly.

(6) Attach the oil cooler (9) to the oil filter housing (12) with one washer (8) and the three self-locking nuts (7). Tighten and torque nuts 32 to 36 lbf.in.

(7) If applicable, install preformed packings (11) on the tube-to-boss elbows (3) and (4).

(8) Install the nuts (2) and back-up rings (13) on the tube-to-boss elbows (3) and (4).

(9) Install the tube-to-boss elbows (3) and (4) in the oil cooler (9). Tighten the nuts (2) fingertight.

NOTE: Torque the nuts (2) after the elbows are aligned with the applicable oil cooler fuel tubes (Ref. Para. 5.K.).

(10) Install the fuel tubes (1) and (10). Refer to para. 5.K.

E. Removal of the JT15D-5 Pressure Fuel Tubes (HMU-to-Oil Cooler-to FDV) (Ref. Fig. 203)

(1) On BS636 installation, remove self-locking nut (8) and bolt (7) from bracket (9) and remove loop clamp (6) securing fuel tube (4).

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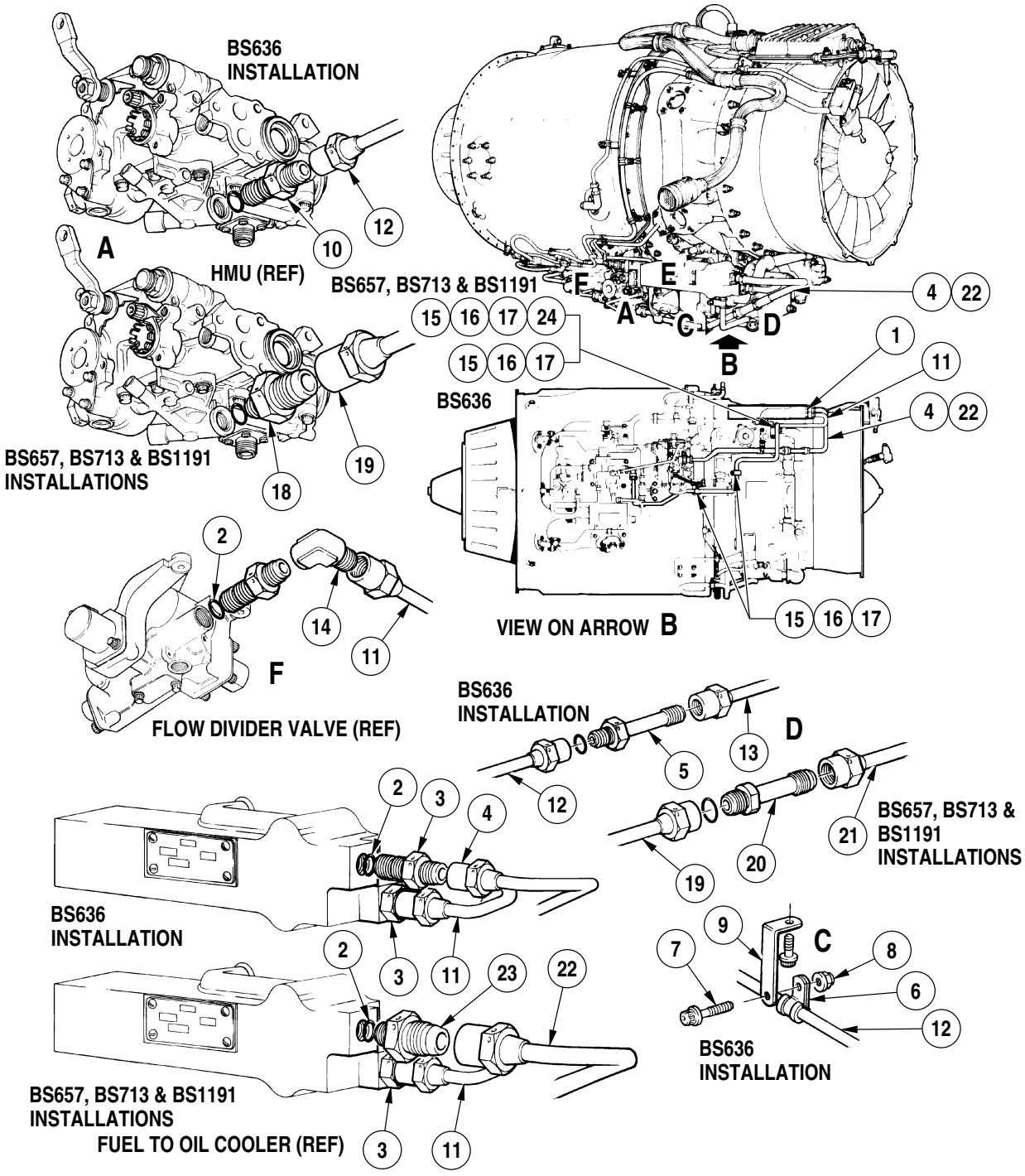

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Removal/Installation - Pressure Fuel Tubes (HMU-to-Oil Cooler-to FDV)
Figure 203

Key to Figure 203

1. Oil Cooler
2. Preformed Packing
3. Straight Nipple
4. Pressure Fuel Tube (to oil cooler - comprises items 5, 12 and 13) (BS636 installation)
5. Coupling Tube (BS636 installation)
6. Loop Clamp (BS636 installation)
7. Bolt (BS636 installation)
8. Self-locking Nut (BS636 installation)
9. Bracket (BS636 installation)
10. Straight Nipple (BS636 installation)
11. Pressure Fuel Tube (to FDV)
12. Pressure Fuel Tube (Nipple to Coupling) (BS636 installation)
13. Pressure Fuel Tube (Coupling to Cooler) (BS636 installation)
14. Elbow
15. Loop Clamp
16. Bolt
17. Self-locking Nut
18. Reducer (BS657, BS713, and BS1191 installations)
19. Pressure Fuel Tube (Nipple to Coupling) (BS657, BS713, and BS1191 installations)
20. Coupling Tube (BS657, BS713, and BS1191installations)
21. Pressure Fuel Tube (Coupling to Cooler) (BS657, BS713, and BS1191 installations)
22. Pressure Fuel Tube (To Oil Cooler - comprises items 19, 20 and 21) (BS657, BS713, and BS1191 installations)
23. Reducer (BS657, BS713, and BS1191 installations)
24. Washer

(2) On BS636 installation, disconnect coupling nuts from straight nipples (3), (10) and remove fuel pressure tube (4) with its coupling (5) or fuel flowmeter, if installed (Ref. 73-10-07).

(3) On BS657, BS713, and BS1191 installations, disconnect coupling nuts from restrictors (18, 23) and remove fuel pressure tube (22) with its coupling (20) or fuel flowmeter, if installed (Ref. 73-10-07).

(4) Remove three self-locking nuts (17) and bolts (16), and one washer (24) (BS657, BS713, and BS1191 installations) and remove loop clamps (15) securing fuel pressure tube (11).

(5) Disconnect coupling nuts at both ends of fuel pressure tube (11).

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(6) If necessary, disconnect fuel pressure tubes (12), (13) from coupling tube (5) (BS636 installation) or tubes (19), (21) from coupling tube (20) (BS657, BS713, and BS1191).

F. Removal of the JT15D-5R Fuel Filter Fuel Tubes (Ref. Fig. 204)

(1) For left engine installations, remove the nut (12) and bolt (11) that attach the clamp (13) to the bracket (10).

(2) For left engine installations, remove the nut (17) and bolt (14) that attaches the clamps (15) and (16) to the bracket (18).

(3) Disconnect the FOHE-to-filter fuel tube (1) from the Fuel/Oil Heat Exchanger (FOHE) (8).

(4) Remove the bolts (2) that attach the FOHE-to-filter fuel tube (1) to the fuel filter (9).

(5) Remove the FOHE-to-filter fuel tube (1). Remove and discard the preformed packing (3) from the tube (1).

(6) Disconnect the filter-to-TBV fuel tube (4) from the Thermostatic Bypass Valve (TBV) (7).

(7) Remove the bolts (5) that attach the filter-to-TBV fuel tube (4) to the fuel filter (9).

(8) Remove the filter-to-TBV fuel tube (4). Remove and discard the preformed packing (6) from the tube (4).

G. Removal of the JT15D-5R Oil Cooler Fuel Tubes (Ref. Fig. 205)

(1) Remove the bolt (19) that attaches the clamp (20) to the bracket (18).

(2) Remove the bolt (17) and nut (14) that attach the clamp (15) to the clamp (16).

(3) Remove the bolt (11) and nut (13) that attach the clamp (12) to the bracket (10) on the FOHE heat shield (5).

(4) Cut the lockwire and disconnect the oil cooler-to-FDV fuel tube (9) from the Flow Divider Valve (FDV) (1) and the oil cooler (4).

(5) Cut the lockwire and disconnect the HMU-to-flowmeter fuel tube (8) from the Hydromechanical Metering Unit (HMU) (2) and the fuel tube coupling (7).

NOTE: If a flowmeter is installed in the place of the fuel tube coupling (7), refer to the Aircraft Maintenance Manual (AMM).

(6) Cut the lockwire and disconnect the flowmeter-to-oil cooler fuel tube (6) from the fuel tube coupling (7) and the oil cooler (3).

NOTE: If a flowmeter is installed in the place of the fuel tube coupling (7), refer to the Aircraft Maintenance Manual (AMM).

(7) Put protective caps and covers on all openings.

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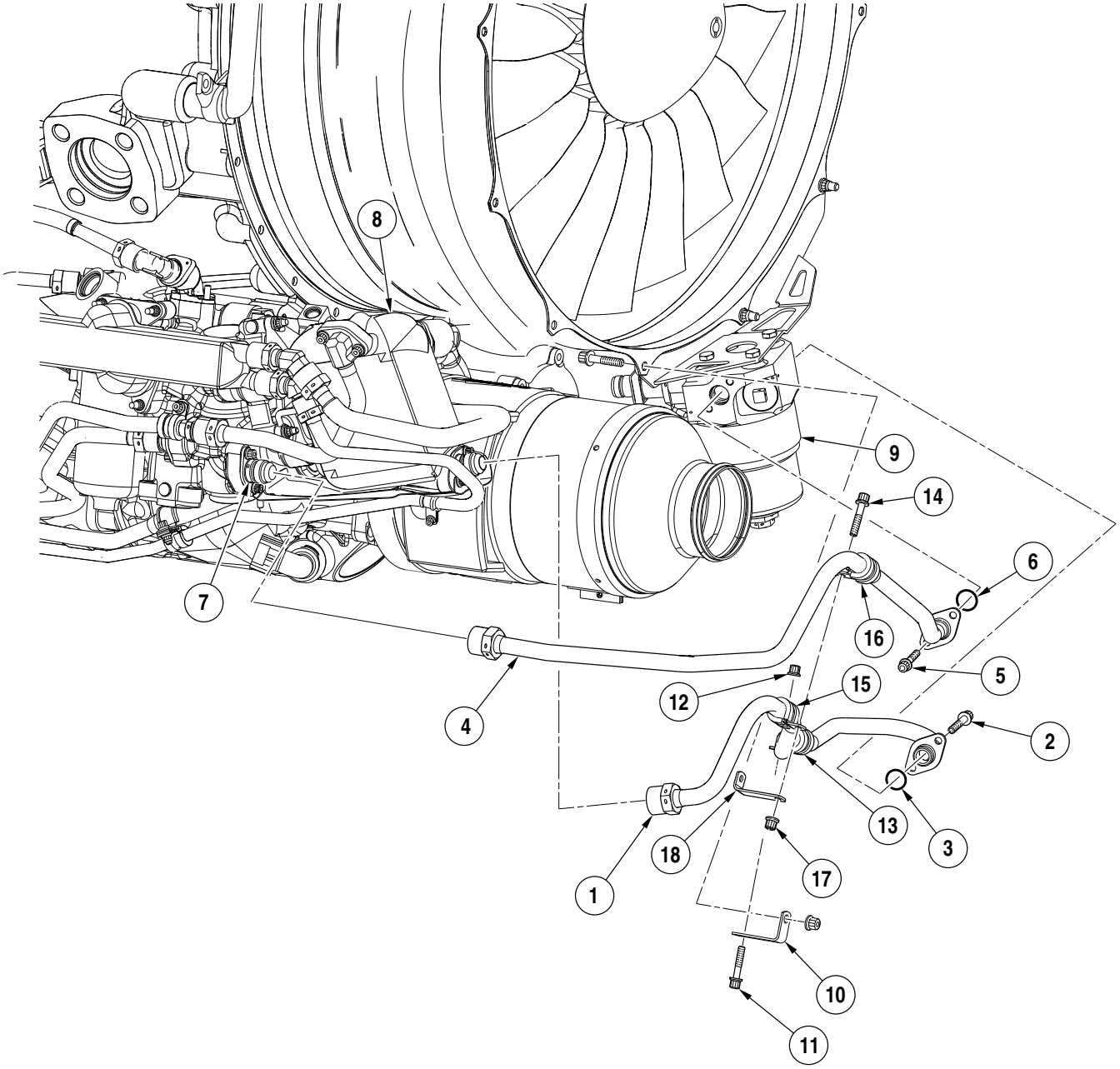

JT15D-5R Left Engine Installation C108939

Removal/Installation - Fuel Filter Fuel Tubes
Figure 204 (Sheet 1 of 2)

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Key to Figure 204

1. FOHE-to-Filter Fuel Tube
2. Bolt
3. Preformed Packing
4. Filter-to-TBV Fuel Tube
5. Bolt
6. Preformed Packing
7. Thermostatic Bypass Valve (TBV)
8. Fuel/Oil Heat Exchanger (FOHE)
9. Fuel Filter
10. Bracket
11. Bolt
12. Nut
13. Loop Clamp
14. Bolt
15. Loop Clamp
16. Loop Clamp
17. Nut
18. Bracket

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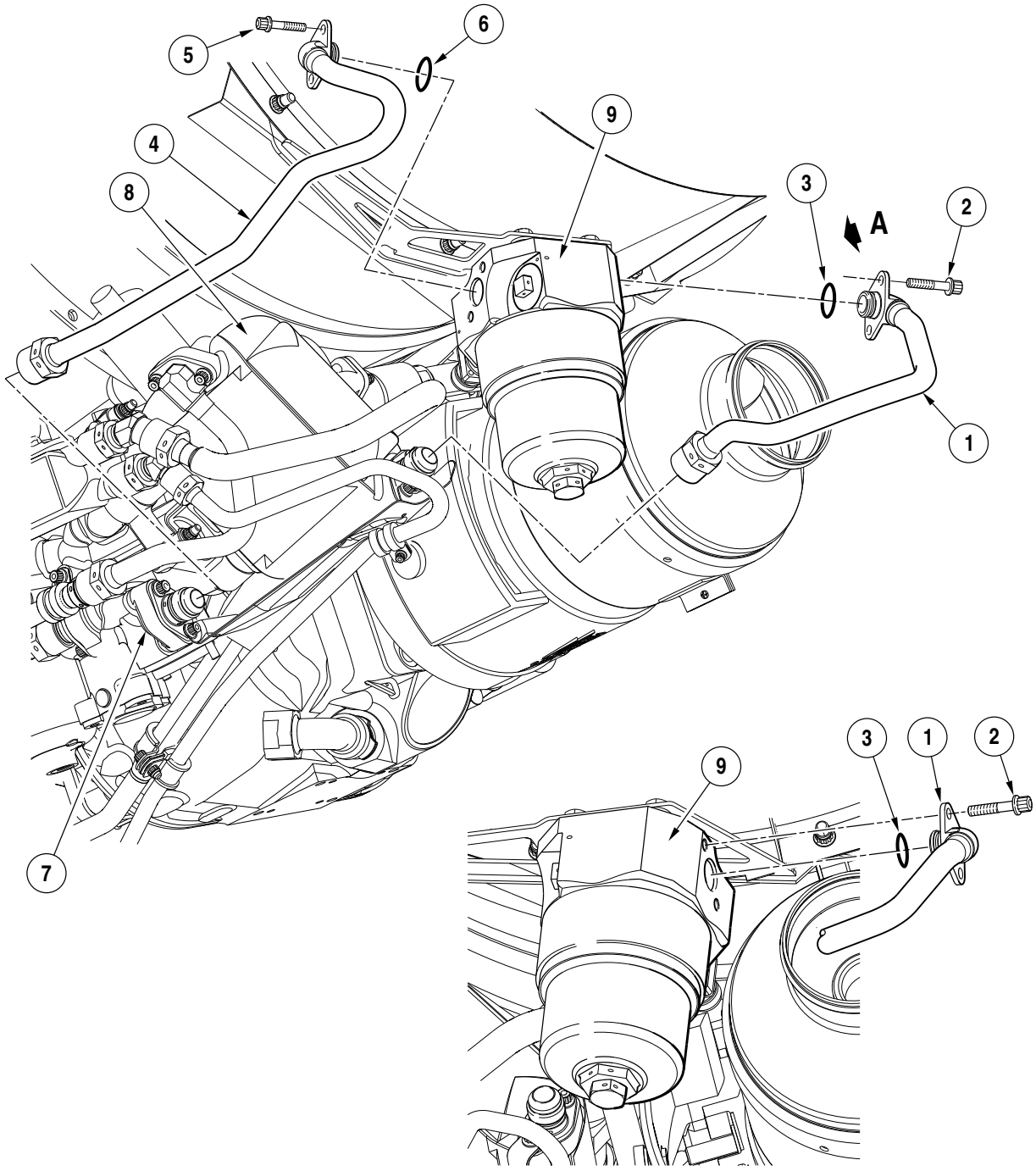

VIEW A

JT15D-5R Right Engine Installation C108979

Removal/Installation - Fuel Filter Fuel Tubes
Figure 204 (Sheet 2)

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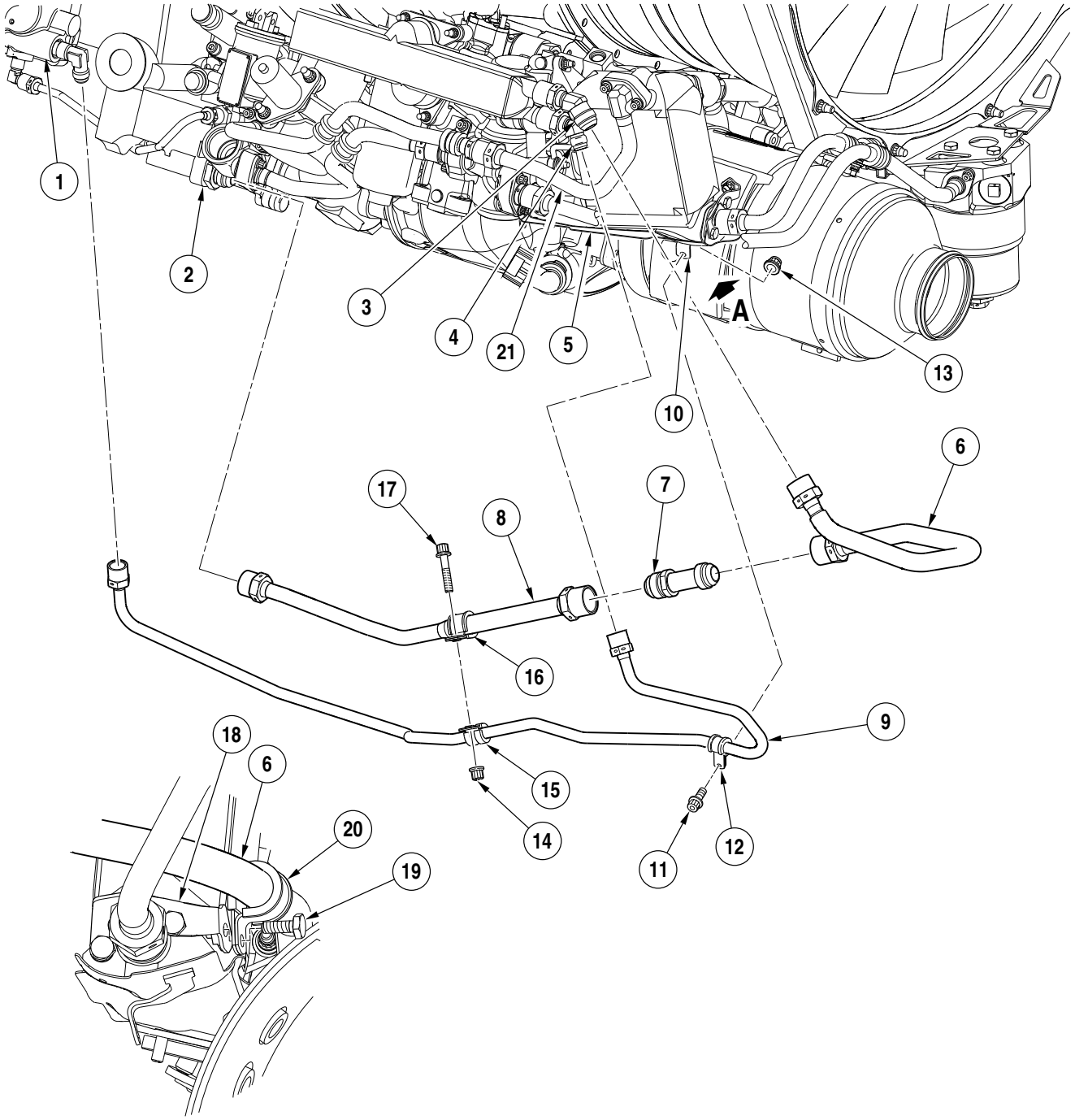

VIEW **A**

JT15D-5R Only

C108914

Removal/Installation - Oil Cooler Fuel Tubes
Figure 205

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Key to Figure 205

1. Flow Divider Valve (FDV)
2. Hydromechanical Metering Unit (HMU)
3. 60° Tube-to-Boss Elbow
4. 45° Tube-to-Boss Elbow
5. FOHE Heat Shield
6. Flowmeter-to-Oil Cooler Fuel Tube
7. Fuel Tube Coupling
8. HMU-to-Flowmeter Fuel Tube
9. Oil Cooler-to-FDV Fuel Tube
10. FOHE Heat Shield Bracket
11. Bolt
12. Loop Clamp
13. Nut
14. Nut
15. Loop Clamp
16. Loop Clamp
17. Bolt
18. Bracket
19. Bolt
20. Loop Clamp
21. Forward Pump-to-FOHE Fuel Tube (Ref.)

H. Removal of the JT15D-5R Fuel Pump Fuel Tubes (Ref. Fig. 206)

(1) Remove the bolt (9) that attaches the loop clamp (8) to the Thermostatic Bypass Valve (TBV) (2).

(2) Remove the nuts (17), bolt (15), spacer (16), and clamps (18) that attach the TBV-to-pump fuel tube (12) to the rear pump-to-FOHE fuel tube (7).

(3) Disconnect the forward pump-to-FOHE fuel tube (4) from the rear pump-to-FOHE fuel tube (7).

(4) Remove the bolts (5) that attach the forward pump-to-FOHE fuel tube (4) to the Fuel/Oil Heat Exchanger (FOHE) (3).

(5) Remove the forward pump-to-FOHE fuel tube (4). Remove and discard the preformed packing (6) from the tube (4).

(6) Remove the bolts (10) that attach the rear pump-to-FOHE fuel tube (7) to the fuel pump (1).

(7) Remove the rear pump-to-FOHE fuel tube (7). Remove and discard the preformed packing (11) from the tube (7).

(8) Disconnect the TBV-to-pump fuel tube (12) from the TBV (2).

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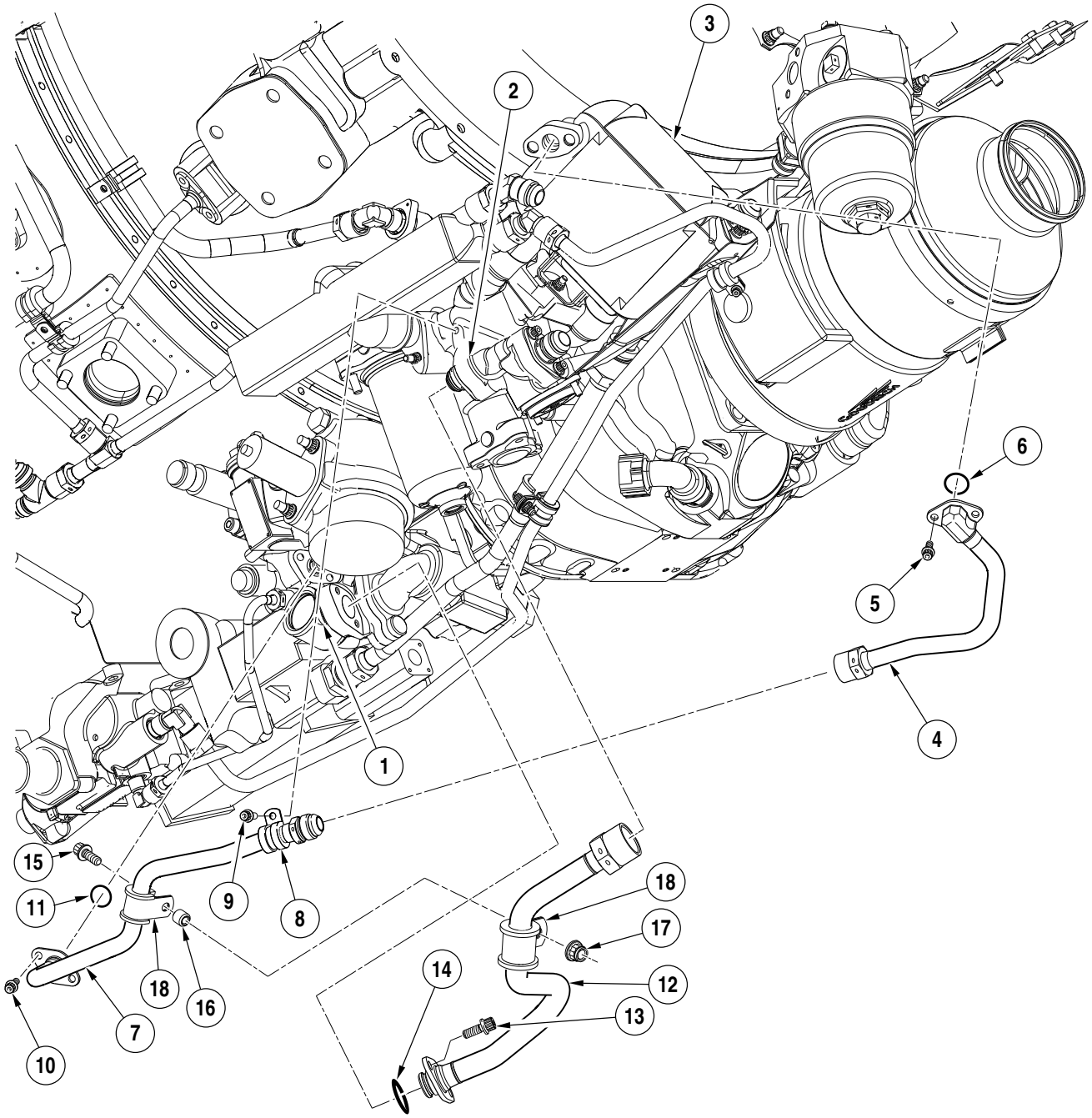

JT15D-5R Only C108940

Removal/Installation - Fuel Pump Fuel Tubes
Figure 206

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Key to Figure 206

1. Fuel Pump
2. Thermostatic Bypass Valve (TBV)
3. Fuel/Oil Heat Exchanger (FOHE)
4. Forward Pump-to-FOHE Fuel Tube
5. Bolt
6. Preformed Packing
7. Rear Pump-to-FOHE Fuel Tube
8. Loop Clamp
9. Bolt
10. Bolt
11. Preformed Packing
12. TBV-to-Pump Fuel Tube
13. Bolt
14. Preformed Packing
15. Bolt
16. Spacer
17. Nut
18. Loop Clamp

(9) Remove the bolts (13) that attach the TBV-to-pump fuel tube (12) to the fuel pump (1).

(10) Remove the TBV-to-pump fuel tube (12). Remove and discard the preformed packing (14) from the tube (12).

I. Installation of the JT15D-5 Pressure Fuel Tubes (HMU-to-Oil Cooler-to FDV) (Ref. Fig. 203)

(1) On BS636 installation, if disassembled, connect pressure fuel tubes (12), (13) loosely to coupling tube (5). Install loop clamp (6) on fuel pressure tube (12). If a fuel flowmeter is to be installed, refer to Chapter 73-10-07.

(2) On BS657, BS713, and BS1191 installations, if disassembled, connect pressure fuel tubes (19), (21) loosely to coupling tube (20). If a fuel flowmeter is to be installed, refer to Chapter 73-10-07.

(3) Install three loop clamps (6) on fuel pressure tube (11) and install fuel pressure tube to straight nipple (3) and elbow (14), tighten and torque coupling nuts to 270 to 300 lb.in. and lockwire.

(4) On BS636 installation, install assembly of fuel pressure tubes (5), (12), (13) or fuel pressure tube with flowmeter, as applicable, between oil cooler straight nipple (30) and straight nipple (10) on HMU. Tighten and torque coupling nuts 450 to 500 lb.in. and lockwire.

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(5) On BS657, BS713, and BS1191 installations, install assembly of fuel pressure tubes (19), (20), (21) or fuel pressure tube with flowmeter, as applicable, between oil cooler (23) and reducer (18) on HMU. Tighten and torque coupling nuts 450 to 500 lb.in. and lockwire. Tighten and torque coupling nuts to coupling tube (20) 650 to 700 lb.in. and lockwire.

(6) Secure loop clamps (15) to brackets with bolts (160 and self-locking nuts (17). On BS657, BS713, and BS1191 installations, install washer (24) at oil filter clamp. Tighten and torque nuts (BS636 installation) or bolts (BS657, BS713, and BS1191 installation) 32 to 36 lb.in.

J. Installation of the JT15D-5R Fuel Pump Fuel Tubes (Ref. Figs. 206 and 207)

(1) Remove all protective caps and covers.

(2) Apply light film of oil (PWC03-001) to preformed packings (6), (11), and (14).

(3) Apply anti-seize (PWC06-009) compound to the tube connections on the Thermostatic Bypass Valve (TBV) (2) and the forward coupling on the rear pump-to-FOHE fuel tube (7).

(4) Install the preformed packing (14) on the TBV-to-pump fuel tube (12).

(5) Connect the TBV-to-pump fuel tube (12) to the fuel pump (1) with the bolts (13). Torque the bolts 36 to 40 lbf.in.

(6) Connect the TBV-to-pump fuel tube (12) to the TBV (2). Torque the coupling 340 to 375 lbf.in. Lockwire the connection.

(7) Install the preformed packing (11) on the rear pump-to-FOHE fuel tube (7).

(8) Install the preformed packing (6) on the forward pump-to-FOHE fuel tube (4).

(9) Connect the rear pump-to-FOHE fuel tube (7) to the forward pump-to-FOHE fuel tube (4).

(10) Connect the rear pump-to-FOHE fuel tube (7) to the fuel pump (1) with the bolts (10). Tighten the bolts fingertight.

(11) Connect the forward pump-to-FOHE fuel tube (4) to the FOHE (3) with the bolts (5). Tighten the bolts fingertight.

(12) Attach the rear pump-to-FOHE fuel tube (7) to the TBV (2) with the clamp (8) and bolt (9). Torque the bolt 36 to 40 lbf.in.

(13) Torque the connection between the tubes (4) and (7) 340 to 375 lbf.in. Lockwire the connection.

(14) Torque the bolts (5) and (10) 36 to 40 lbf.in.

(15) Attach the rear pump-to-FOHE fuel tube (7) to the TBV-to-pump fuel tube (12) with the clamps (18), spacer (16), bolt (15), and nut (17). Torque the nut 36 to 40 lbf.in.

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(16) Do the required ground checks (Ref. 71-00-00, ADJUSTMENT/TEST).

K. Installation of the JT15D-5R Oil Cooler Fuel Tubes (Ref. Fig. 205 and 207)

(1) Remove all protective caps and covers.

(2) Install the HMU-to-flowmeter fuel tube (8), flowmeter-to-oil cooler fuel tube (6), and fuel tube coupling (7) as follows:

(a) Apply anti-seize (PWC06-009) compound to the fuel tube coupling (7).

(b) Connect the HMU-to-flowmeter fuel tube (8) and flowmeter-to-oil cooler fuel tube (6) to the fuel tube coupling (7). Tighten the couplings fingertight only.

(c) Align the 45° tube-to-boss elbow (3) to the tube assembly. Align the other end of the tube assembly with the tube nipple on the HMU (1). Connect the couplings of the tube assembly to the elbow and nipple fingertight only.

(d) Attach the tube assembly to the bracket (18) with the clamp (20) and bolt (19).

(e) Make sure the clearance between the flowmeter-to-oil cooler fuel tube (6) and the forward pump-to-FOHE fuel tube (21) is 0.109 inches minimum (Ref. Fig. 207).

NOTE: If necessary, loosen the connections and adjust the position of the tubes and the tube-to-boss elbow until the tube assembly is correctly installed. Re-tighten all connections.

(f) Torque the nut on the 45° tube-to-boss elbow (3) 70 to 80 lbf.in.

(g) Remove the bolt (19) and clamp (20) from the bracket (18).

(h) Remove the tube assembly from the engine. Torque the HMU-to-flowmeter fuel tube (8) and flowmeter-to-oil cooler fuel tube (6) to the fuel tube coupling (7) 475 to 525 lbf.in. Lockwire the connections.

NOTE: Refer to the Aircraft Maintenance Manual (AMM) for installation of the flowmeter.

(i) Apply anti-seize (PWC06-009) compound to the Hydromechanical Metering Unit (HMU) (2) tube nipple and tube-to-boss elbow (3).

(j) Re-install the tube assembly from the HMU (2) to the oil cooler.

(k) Attach the tube assembly to the bracket (18) with the clamp (20) and bolt (19). Torque the bolt 36 to 40 lbf.in.

(l) Torque the couplings at the HMU and oil cooler 45° tube-to-boss elbow (3) 340 to 375 lbf.in. Lockwire the connections.

(3) Install the oil cooler-to-FDV fuel tube (9) as follows:

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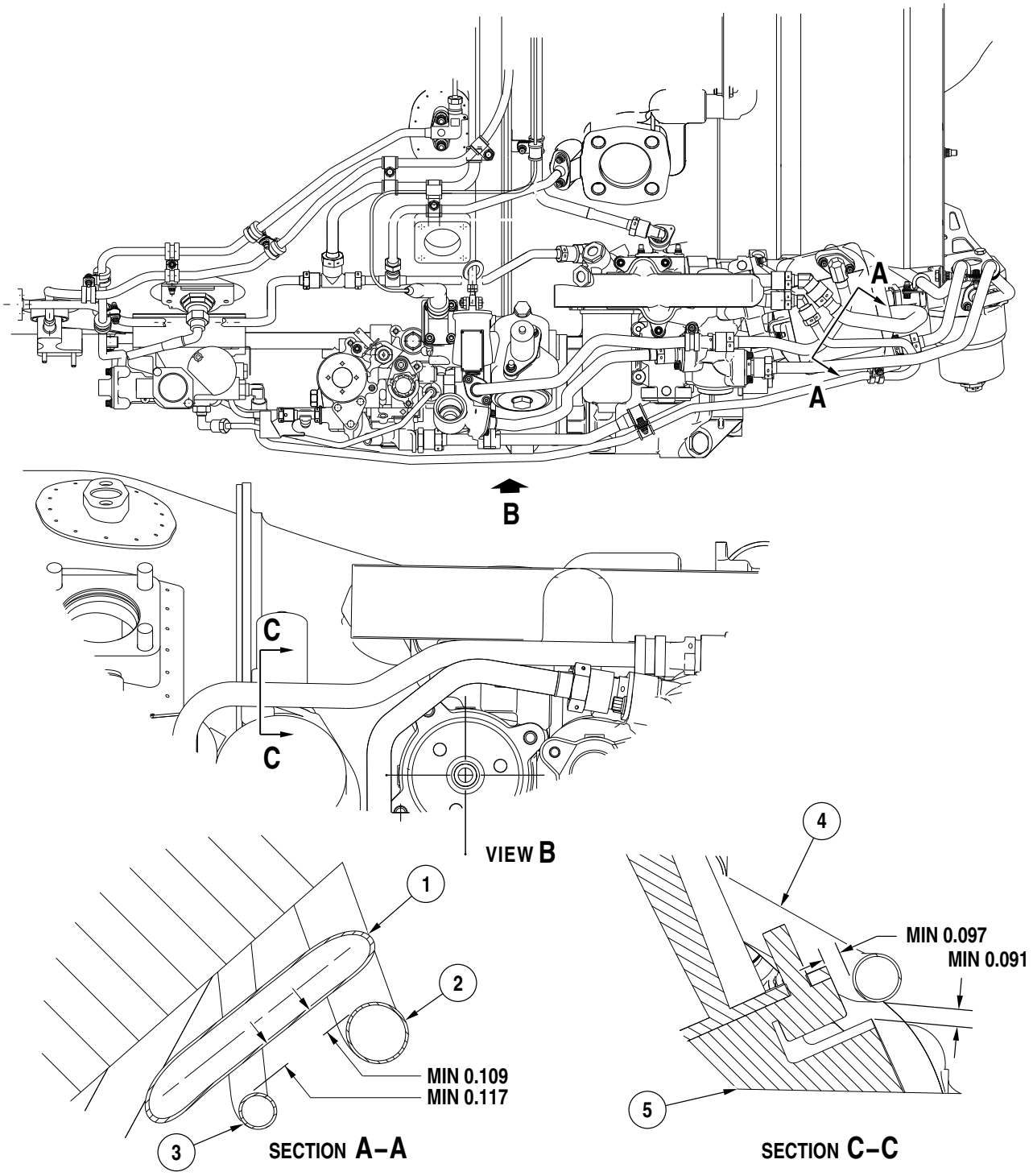

JT15D-5R Only

C112603

Fuel Tube Installation - Clearances
Figure 207

Key to Figure 207

1. Forward Pump-to-FOHE Fuel Tube
2. Thermostatic Bypass Valve (TBV)
3. Flowmeter-to-Oil Cooler Fuel Tube
4. Rear Pump-to-FOHE Fuel Tube
5. Fuel Pump

(a) Apply anti-seize (PWC06-009) compound to the elbow on the Flow Divider Valve (FDV) (1)and oil cooler tube-to-boss elbow (4).

(b) Connect the oil cooler-to-FDV fuel tube (9) to the FDV (1) and oil cooler 60° tube-to-boss elbow (4).

(c) Attach the oil cooler-to-FDV fuel tube (9) to the FOHE heat shield bracket (10) with the loop clamp (12), bolt (11) and nut (13).

(d) Make sure the clearance between the oil cooler-to-FDV fuel tube (9) and the forward pump-to-FOHE fuel tube (21) is 0.117 inches minimum (Ref. Fig. 207).

NOTE: If necessary, loosen the connections and adjust the position of the tubes and the tube-to-boss elbow until the tube assembly is correctly installed. Re-tighten all connections.

(e) Tighten the nut on the 60° tube-to-boss elbow (4) 70 to 80 lbf.in.

(f) Torque the nut (13) 36 to 40 lbf.in.

(g) Torque the oil cooler-to-FDV fuel tube (9) couplings 200 to 225 lbf.in. Lockwire the connections.

(4) Attach the HMU-to-flowmeter fuel tube (8) to the oil cooler-to-FDV fuel tube (9) with the loop clamps (15) and (16), bolt (17) and nut (14). Torque the nut (14) 36 to 40 lbf.in.

(5) Do the required ground checks (Ref. 71-00-00, ADJUSTMENT/TEST).

L. Installation of the JT15D-5R Fuel Filter Fuel Tubes (Ref. Fig. 204)

(1) Remove all protective caps and covers.

(2) Apply a light film of oil (PWC03-001) to preformed packings (3) and (6).

(3) Apply anti-seize (PWC06-009) compound to the tube connections on the Thermostatic Bypass Valve (TBV) (7) and Fuel/Oil Heat Exchanger (FOHE) (8).

(4) Install the preformed packing (3) on the FOHE-to-filter fuel tube (1).

(5) Connect the FOHE-to-filter fuel tube (1) to the filter (9) with the bolts (2). Torque the bolts 36 to 40 lbf.in.

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(6) Connect the FOHE-to-filter fuel tube (1) to the FOHE (8). Torque the coupling 340 to 375 lbf.in. Lockwire the connection.

(7) Install the preformed packing (6) on the filter-to-TBV fuel tube (4).

(8) Connect the filter-to-TBV fuel tube (4) to the filter (9) with the bolts (5). Torque the bolts 36 to 40 lbf.in.

(9) Connect the filter-to-TBV fuel tube (4) to the TBV (7). Torque the coupling 340 to 375 lbf.in. Lockwire the connection.

(10) For left engine installations, do the steps that follow:

(a) Attach the FOHE-to-filter fuel tube (1) to the bracket (10) with the loop clamp (13), bolt (11), and nut (12). Torque the nut 36 to 40 lbf.in.

(b) Attach the FOHE-to-filter fuel tube (1) and the filter-to-TBV fuel tube (4) to the bracket (18) with loop clamps (15) and (16), bolt (14) and nut (17). Torque the nut 36 to 40 lbf.in.

(11) Do the required ground checks (Ref. 71-00-00, ADJUSTMENT/TEST).

6. Adjustment/Test

A. Oil Cooler - Oil Flow Check and Pressure Check (Ref. Fig. 201)

(1) Blank off fuel outlet, using a suitable metal blanking cap assembly.

(2) Support cooler on bench, oil ports upwards, and prime oil side of cooler with engine oil (PWC03-001) through one port, until oil flows freely from other port.

(3) If oil flow is not free and unrestricted, reject cooler.

WARNING: SCREEN THE OIL COOLER BEFORE PRESSURIZING TO PROVIDE ADEQUATE PROTECTION FOR PERSONNEL WITHIN THE VICINITY.

(4) Connect nitrogen source (PWC05-050)to fuel inlet connection on cooler and pressurize to 500 psi.

(5) Observe oil ports. If bubbles of nitrogen appear, reject cooler.

(6) If a replacement oil cooler was installed, perform required ground checks (Ref. 71-00-00, ADJUSTMENT/TEST).

7. Inspection/Check

A. Oil Cooler

(1) JT15D-5 (Pre-SB7412) engines: damaged or missing surface coating is allowable.

(2) JT15D-5 (Post-SB7412) and JT15D-5R engines: damage of chafing to a maximum depth of 0.025 inch and round bottomed is acceptable without repair, provided that 0.600 inch at each end of the oil cooler is not damaged.

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B. Pressure Fuel Tubes

(1) Scratches - Minor scratches having no appreciable depth are acceptable. Scratches to a depth of 0.005 inch must be blended out. Replace tubing with scratches over 0.005 inch deep.

(2) Nicks - Individual nicks up to 0.062 inch long by 0.010 inch wide and 0.003 inch deep can be ignored. Nicks to a maximum depth of 0.005 inch must be blended out to remove sharp edges. Replace tubing with nicks greater than 0.005 inch deep.

(3) Dents - Round bottomed dents on straight sections of tubing are permitted, provided the length and depth are not greater than 10 percent of the normal outside diameter of tube. No more than one dent to maximum depth per 12 inch length of tube is acceptable. Dents on tube bends, which cause restriction by flattening and local weakening, are not acceptable.

(4) Pitting - Minor isolated pitting up to 0.003 inch deep is acceptable. Clusters of pitting should be blended out to a maximum depth of 0.005 inch. Tubing must be replaced if pitting exceeds 0.005 inch deep.

(5) Corrosion - Staining on tubing and surface corrosion is acceptable if removed by light polishing with crocus cloth and oil.

8. Cleaning/Painting

A. Pressure Fuel Tubes

(1) Clean exterior of tube by spraying with petroleum solvent (PWC11-027) using a soft bristle brush, as necessary. Dry using compressed air, observing all normal ventilation and fire safety precautions.

(2) Clean tube interior by pressure flushing with petroleum solvent (PWC05-004). Dry using clean, filtered compressed air, taking particular care that no foreign matter remains in tube.

(3) Cap tube ends immediately after cleaning and until tube is to be installed on engine to prevent entry of foreign matter.

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FUEL PUMP - DESCRIPTION AND OPERATION

1. Fuel Pump (Ref. Fig. 1)

The engine-driven fuel pump is mounted on and driven from the engine accessory gearbox (Ref. Fig. 1). The pump rear face forms the mounting flange for the bleed valve actuator and HMU. The main fuel pump has a centrifugal boost stage and a gear type positive displacement unit which contains a single pair of matched spur gears riding in four replaceable bearings fitted to the pump housing. Two of the bearings are spring loaded to ensure a tight seal between gear faces and bearing faces.

The JT15D-5 pump housing contains a 74 micron inlet screen incorporating an internal bypass feature, and a 10 micron disposable element discharge filter with a bypass valve. The JT15D-5R has only the 10 micron disposable element discharge filter with bypass valve. The JT15D-5R also has a boost discharge port after the low pressure centrifugal stage to send fuel to the Fuel/Oil Heat Exchanger (FOHE) and a 40 micron fuel filter. The heated and filtered fuel returns to the JT15D-5R fuel pump through the gear inlet port.

For the JT15D-5R, an over-temperature indicator is installed on the fuel pump. It is a pop-up type indicator that is manually reset.

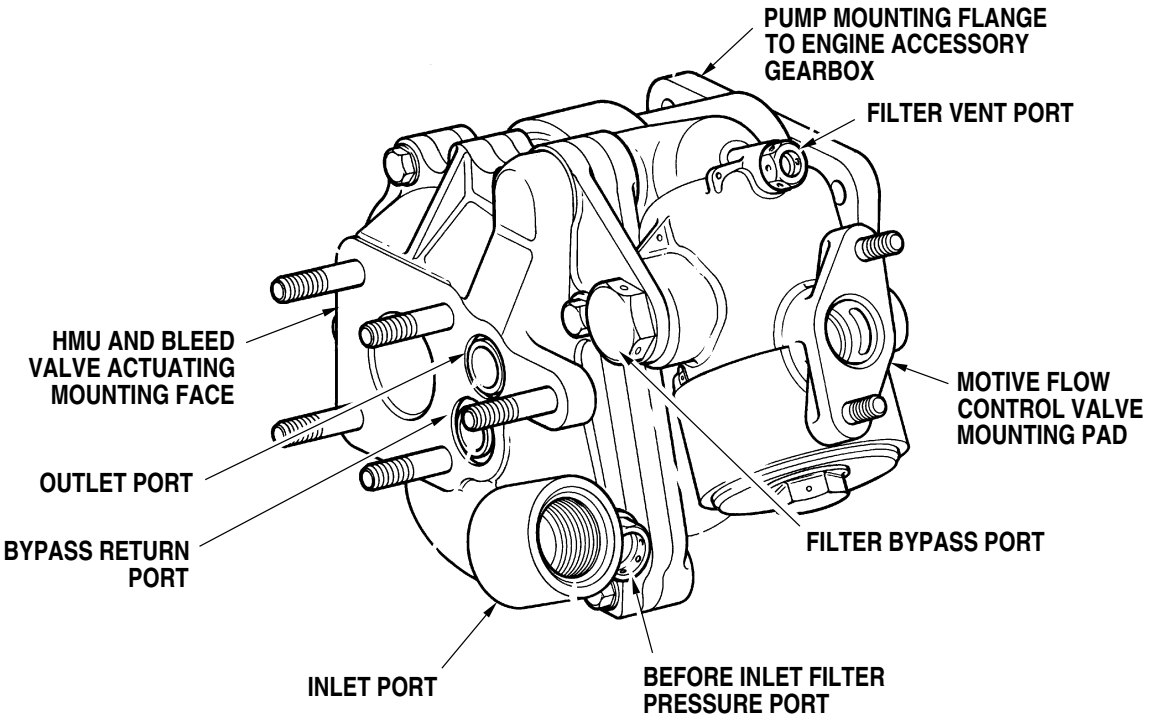
2. Operation (Ref. Fig. 1)

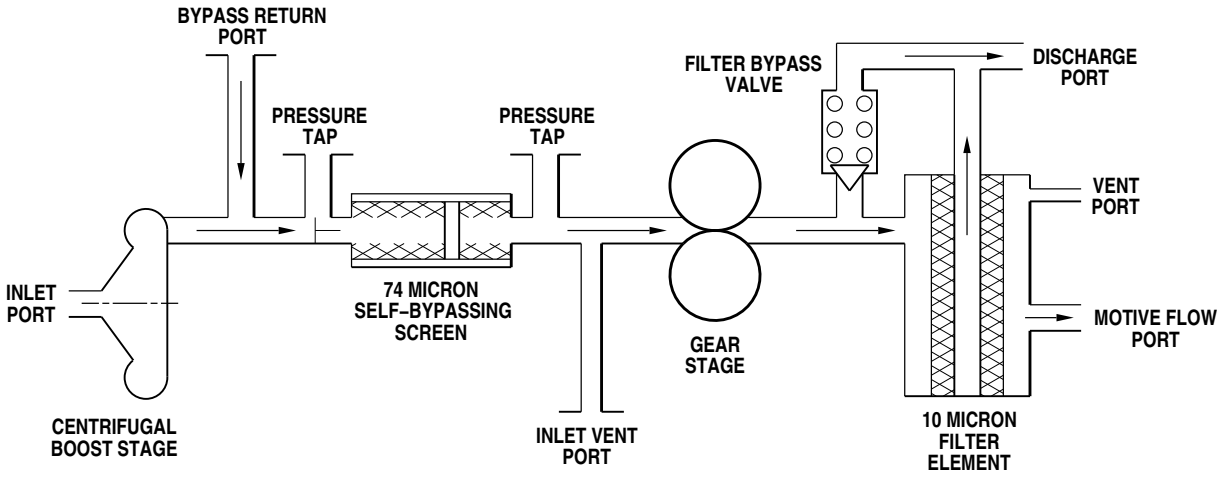
Fuel enters the pump through the inlet port to a radial flow centrifugal impeller boost stage. For the JT15D-5, internal passages in the pump housing conduct the fuel via an inlet filter to the inlet side of the gear cavity. For the JT15D-5R, the fuel leaves the pump through a boost discharge port after the centrifugal impeller boost stage. The fuel is routed through the FOHE and a fuel filter. The heated and filtered fuel returns to the fuel pump through the gear inlet port. Internal passages in the pump housing conduct the fuel to the inlet side of the gear cavity.

When the main drive shaft rotates, the drive gear rotates within the close-fitting gear pockets of the main gear housing. The gear teeth on the drive and driven gears are in constant mesh, and the driven gear also rotates.

During pump operation, fuel at the inlet side of the gear cavity is trapped in the spaces between the gear teeth, pump housing, and bearings; this fuel is carried around the outside of the gears to the outlet side of the gear cavity. As the gear teeth mesh, the fuel is forced from the spaces between the gear teeth. Because of close pump tolerances, reverse flow through the pump is impossible, so that the only direction in which the fuel can flow is through the discharge port passage to the outlet port.

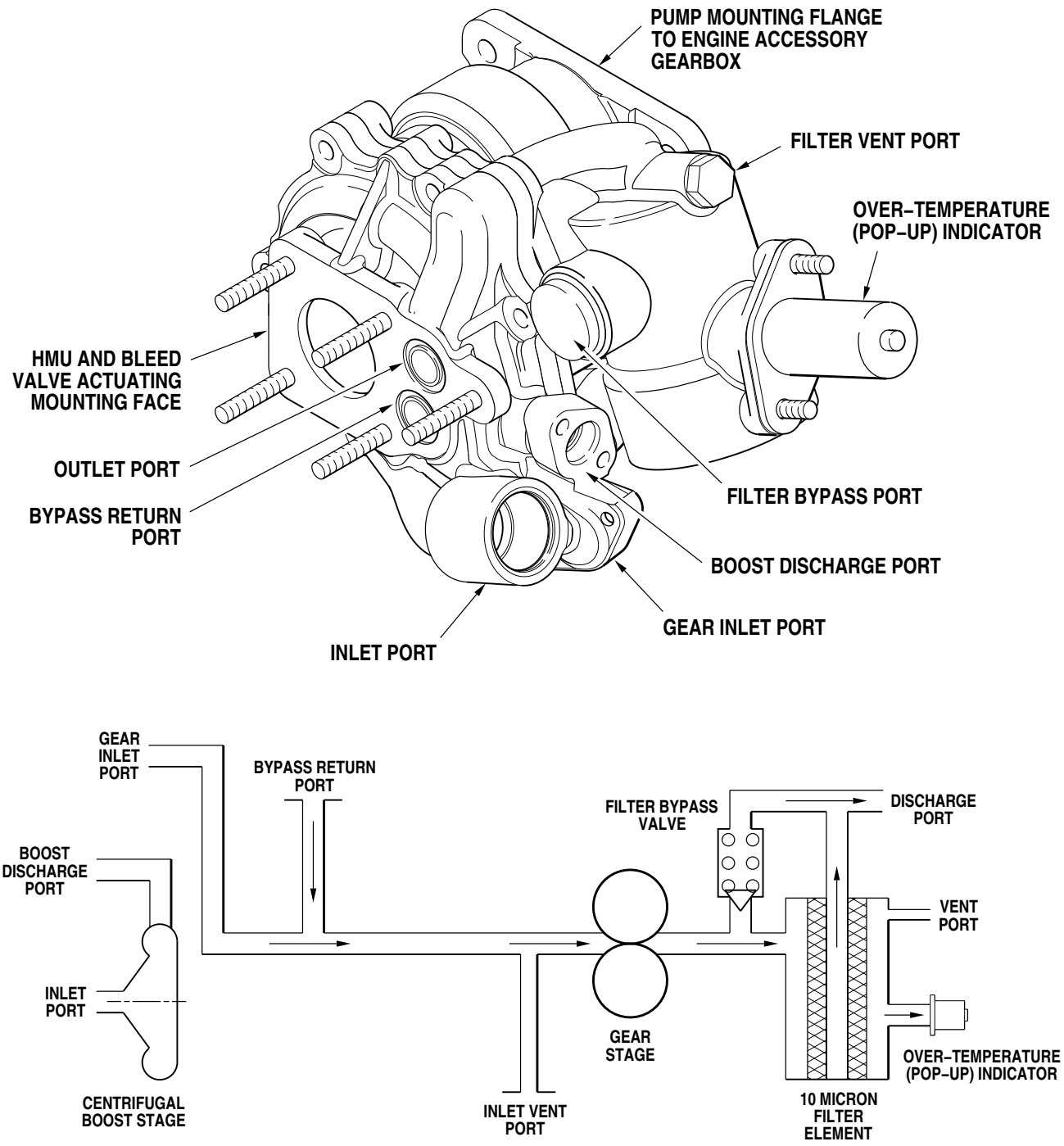
As fuel meets resistance to the flow beyond the fuel pump, pressure builds up as more fuel continues to be transferred from the inlet to the discharge side. For the JT15D-5, excess fuel is returned to the pump bypass port where it is mixed with incoming fuel from the centrifugal boost stage and directed through internal passages to the inlet filter. The boost stage discharge pressure forces the fuel through the filter to the gear stage inlet port. For the JT15D-5R, excess fuel is returned to the pump bypass port where it is mixed with the heated, filtered fuel from the gear inlet port. The fuel is directed to the gear stage inlet port.


PUMP MOUNTING FLANGE TO ENGINE ACCESSORY GEARBOX
FILTER VENT PORT
HMU AND BLEED VALVE ACTUATING MOUNTING FACE
MOTIVE FLOW CONTROL VALVE MOUNTING PAD
OUTLET PORT
BYPASS RETURN PORT
FILTER BYPASS PORT
INLET PORT
BEFORE INLET FILTER PRESSURE PORT



JT15D-5 Engines C108769

Main Fuel Gear Pump - Description/Operation
Figure 1 (Sheet 1 of 2)



JT15D-5R Engines C108770

Main Fuel Gear Pump - Description/Operation
Figure 1 (Sheet 2)

The centrifugal impeller boost stage is clamped to the drive gear journal by means of a multi-function fastener.

For the JT15D-5, should the inlet screen become restricted, the increased pressure drop across the screen will cause it to unseat, allowing unfiltered fuel to enter the pump element. For both JT15D-5 and JT15D-5R engines, restrictions of the discharge filter with a resulting pressure differential rise across the filter above a preset value will open the bypass valve allowing pump delivery fuel to bypass the filter. In addition, any suction created by the gear stage is sufficient to initiate pump operation.

For the JT15D-5R, a over-temperature indicator is installed on the fuel pump. It is a pop-up type indictor that is manually reset. The pop-up button will extend when the fuel temperature is 185 ±9°C. The button can be manually reset when the fuel temperature decreases below 150°C. A degraded thermostatic bypass valve combined with hot environmental conditions can cause a fuel over-temperature indication.

FUEL PUMP - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the fuel pump.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Engine Lubricating Oil
PWC11-027	Petroleum Solvent

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Servicing

   A. Removal of Filters (Ref. Fig. 201)

      (1) For the JT15D-5: Remove fuel pump 74 micron inlet screen as follows:

         (a) Unscrew and carefully remove plug (8).

         (b) Remove and discard preformed packing (7) from plug (8).

         (c) Unscrew and carefully remove inlet screen and cover assembly (6). Remove and discard preformed packing (5).

      (2) For the JT15D-5 and JT15D-5R: Remove fuel pump 10 micron outlet filter as follows:

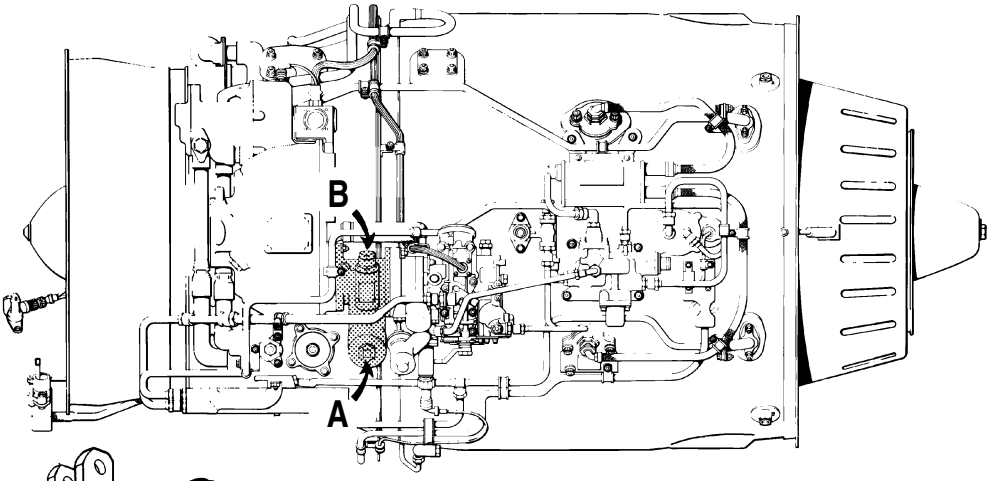
         CAUTION: THE OUTLET FILTER ELEMENT IS DISPOSABLE AND MUST BE DISCARDED. DO NOT CLEAN.

         (a) Unscrew cap nut (4) and remove filter element (2). Discard filter element (2) and preformed packing (1).

         (b) Remove and discard preformed packing (3) from cap nut (4).

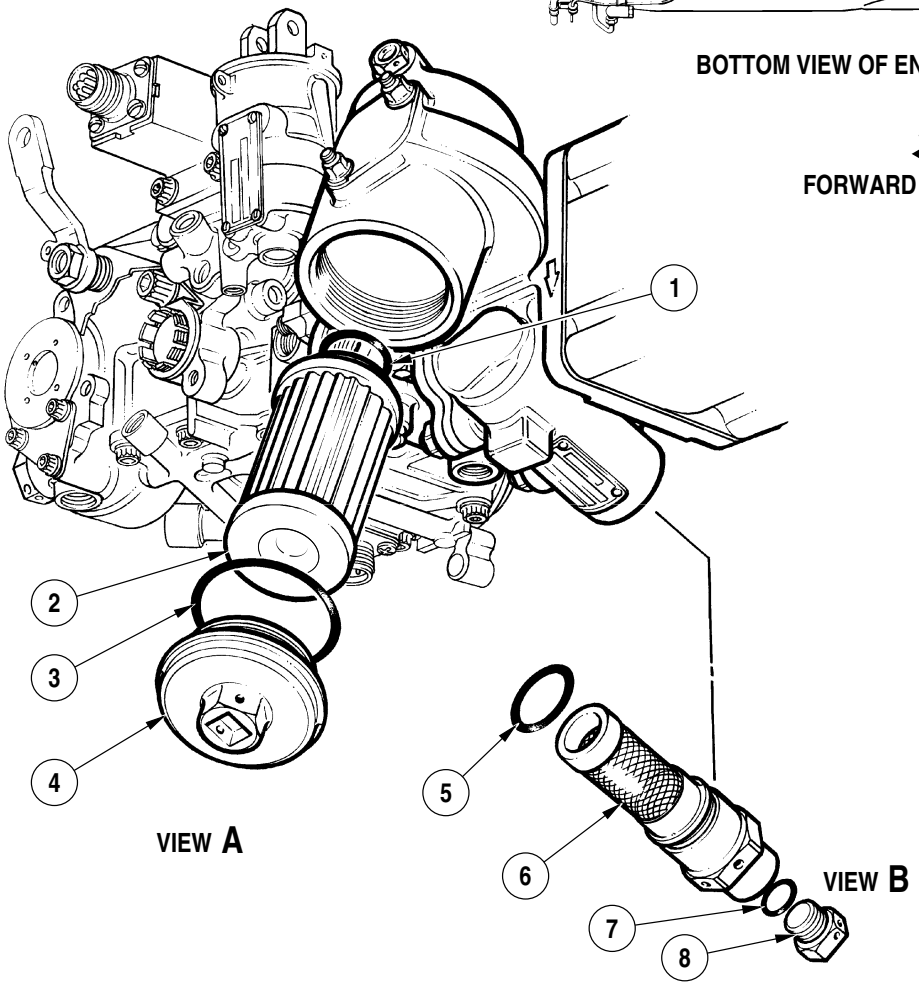
   B. Cleaning and Inspection

      (1) For the JT15D-5: Clean inlet filter screen and cover assembly (6) as detailed in Paragraph 9., following:



BOTTOM VIEW OF ENGINE

FORWARD



VIEW A

VIEW B

JT15D-5 Only

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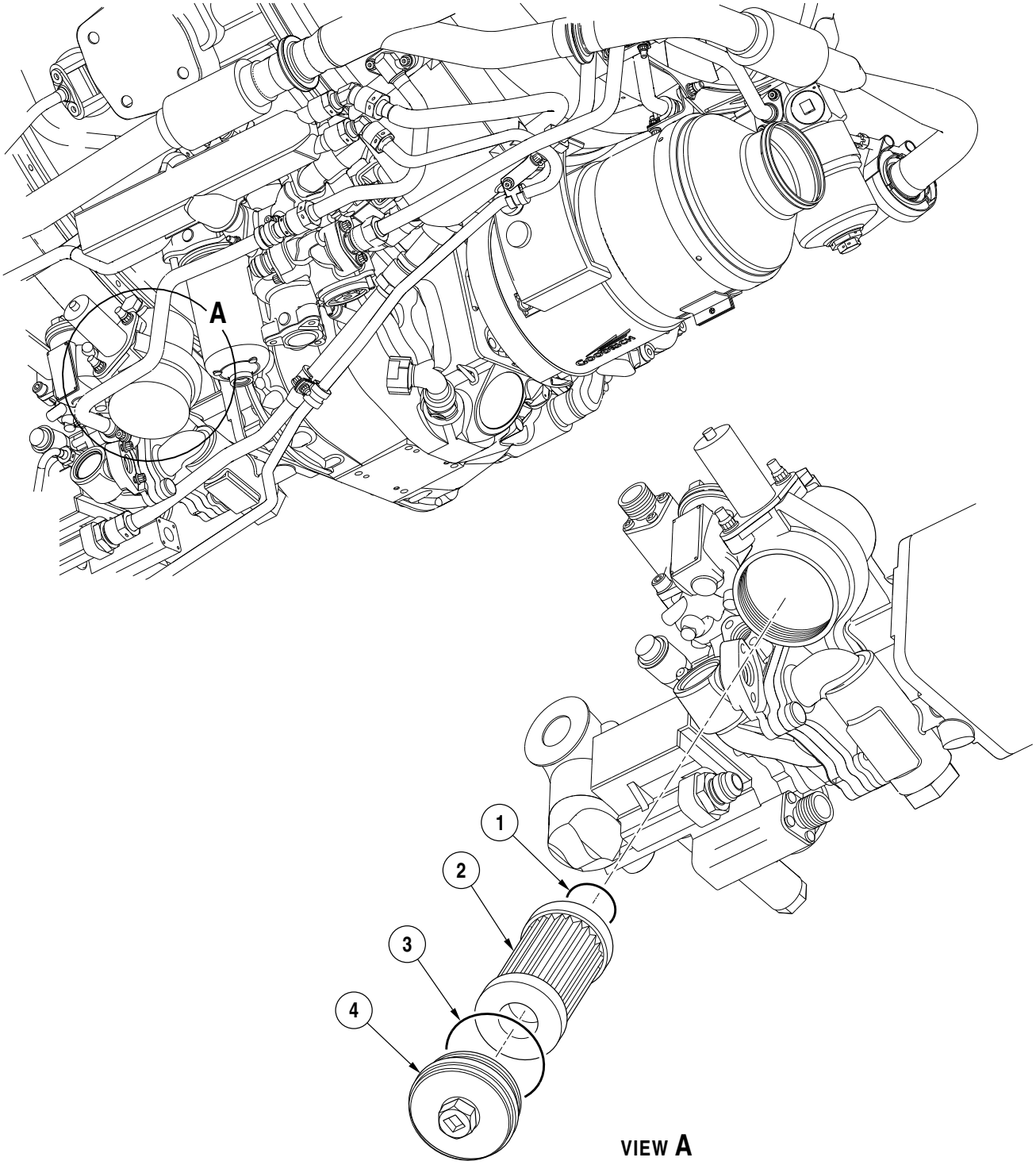
Removal/Installation - Fuel Pump Filters
Figure 201 (Sheet 1 of 2)



JT15D-5R Only

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Removal/Installation - Fuel Pump Filters
Figure 201 (Sheet 2)

Key to Figure 201

1. Preformed Packing
2. Filter Element
3. Preformed Packing
4. Cap Nut
5. Preformed Packing
6. Inlet Screen and Cover Assembly
7. Preformed Packing
8. Plug

(2) For the JT15D-5 and JT15D-5R: Do not clean outlet filter (2) which is of the disposable type and must be discarded.

C. Installation of Filters (Ref. Fig. 201)

(1) For the JT15D-5: Install fuel pump 74 micron filter inlet screen as follows:

(a) Lubricate preformed packings (5) and (7) with light film of engine oil (PWC03-001).

(b) Ensure inlet screen and cover assembly (6) is clean.

(c) Install new preformed packing (5) in groove on inlet screen and cover assembly (6).

(d) Insert filter screen and cover assembly (6) in housing of pump body.

(e) Tighten and torque assembly (6) to 125 to 150 lb.in. and lockwire.

(f) Install new preformed packing (7) on plug (8), insert plug in assembly (6). Tighten and torque plug to 33 to 45 lb.in. and lockwire.

(2) For the JT15D-5 and JT15D-5R: Install fuel pump 10 micron output filter element as follows:

(a) Lubricate preformed packings (1) and (3) with light film of engine oil (PWC03-001).

(b) Install new preformed packing (1) in inner end of filter element (2).

(c) Install new preformed packing (3) on cap nut (4).

CAUTION: DO NOT INVERT OUTLET FILTER WHEN INSTALLING IN FUEL PUMP.

(d) Insert new fuel filter element (2) into fuel pump with open end of filter first and install cap nut (4) .

(e) Tighten cap nut (4), torque to 150 lb.in. and lockwire.

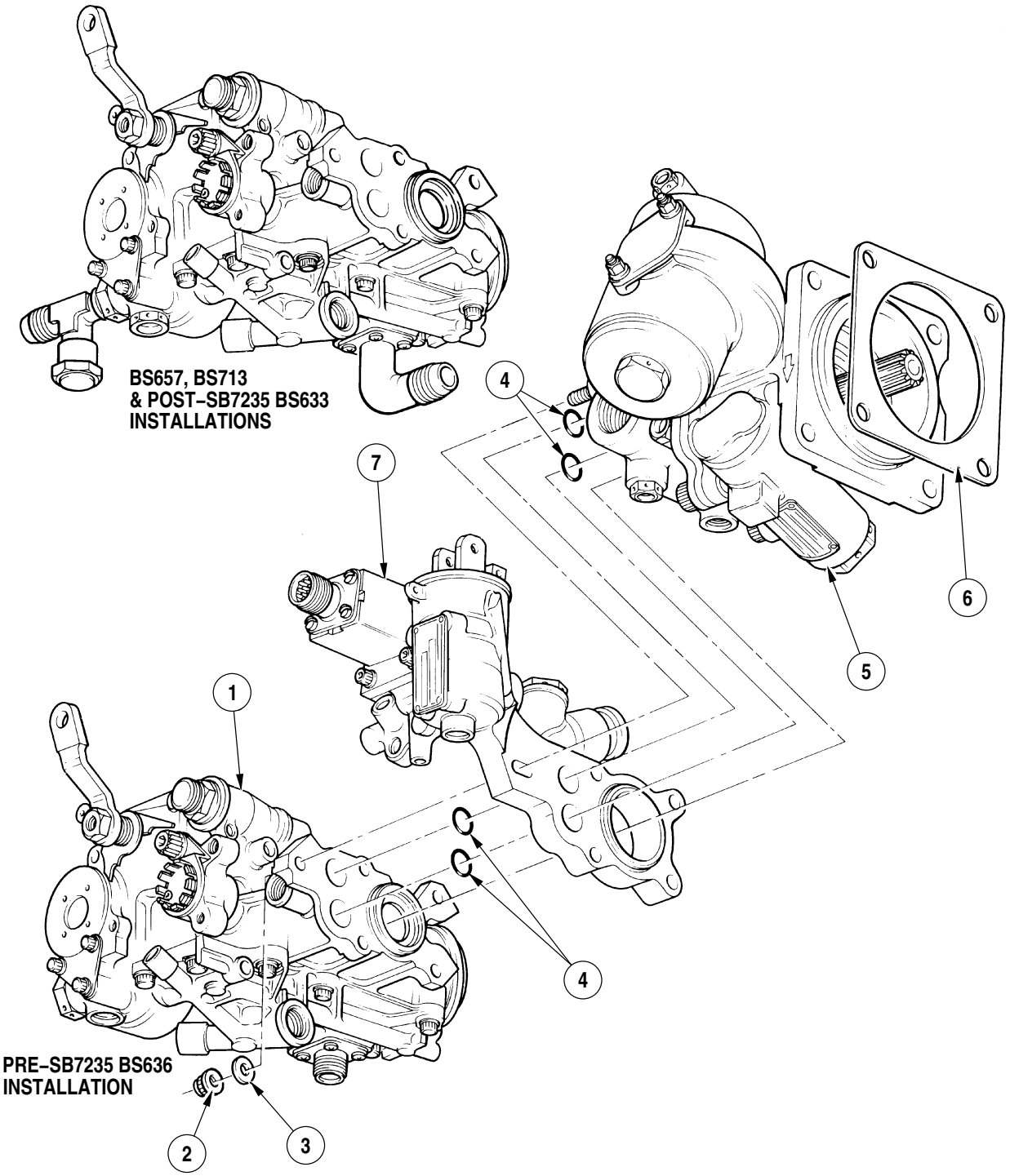
6. Removal/Installation

A. Removal of Fuel Pump (Ref. Fig. 202)

NOTE: The HMU is mounted on the pump rear face. Experience dictates that the HMU, bleed valve actuator and pump should be removed as an assembly and then separated on a bench.

(1) Remove and separate HMU, bleed valve actuator and fuel pump (Ref. 73-20-02). Discard gasket (6).

(2) Remove five self-locking nuts (2) and washers (3) securing HMU (1) and bleed valve actuator (7) to the fuel pump (5).



JT15D-5 Only

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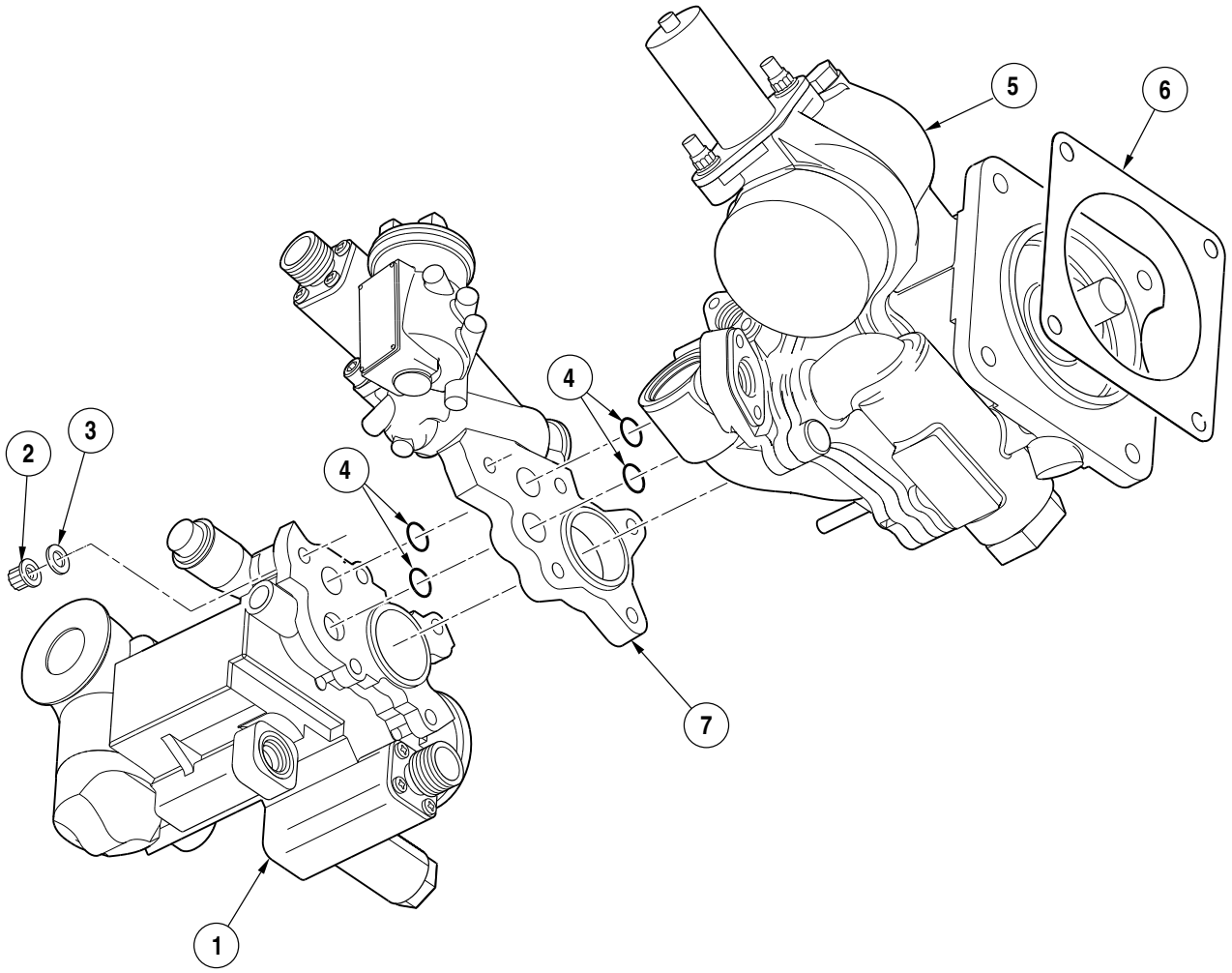
Removal/Installation - Fuel Pump
Figure 202 (Sheet 1 of 2)



JT15D-5R Only

C108823

Removal/Installation - Fuel Pump
Figure 202 (Sheet 2)

Key to Figure 202

1. Hydromechanical Metering Unit (HMU)
2. Self-locking Nut
3. Washers
4. Preformed Packing
5. Fuel Pump
6. Gasket
7. Bleed Valve Actuator

(3) Separate the three units and discard four preformed packings.

(4) Install protective caps on both units and store separately in suitable containers.

B. Installation of Fuel Pump (Ref. Fig. 202)

NOTE: The HMU, bleed valve actuator and fuel pump are assembled on a bench and then installed as one unit.

(1) Remove protective caps, remove protective grease from pump splines and lightly lubricate splines with engine oil (Ref. SB7001).

(2) Position two new preformed packings (4) in fuel pump face recesses and two new preformed packings (4) in HMU face recesses.

(3) Install bleed valve actuator on fuel pump rear face.

(4) Install HMU on bleed valve actuator rear face and secure with five washers (3) and self-locking nuts (2). Tighten and torque nuts to 75 to 85 lb.in.

(5) Remove protective caps, remove protective grease from pump splines and lightly lubricate splines with engine oil (PWC03-001).

(6) Refer to Chapter 73-20-02 and complete installation of HMU, bleed valve actuator and fuel pump.

C. Removal of the Overtemperature Popup Indicator (JT15D-5R) (Ref. Fig. 203)

(1) Remove the nuts (2) and washers (3) that attach the overtemperature popup indicator (1) from the fuel pump (6).

(2) Remove the overtemperature popup indicator (1) from the fuel pump (6).

(3) Remove and discard the preformed packings (4) and (5) from overtemperature popup indicator (1).

(4) Put protective covers and caps in the openings.

D. Installation of the Overtemperature Popup Indicator (JT15D-5R) (Ref. Fig. 203)

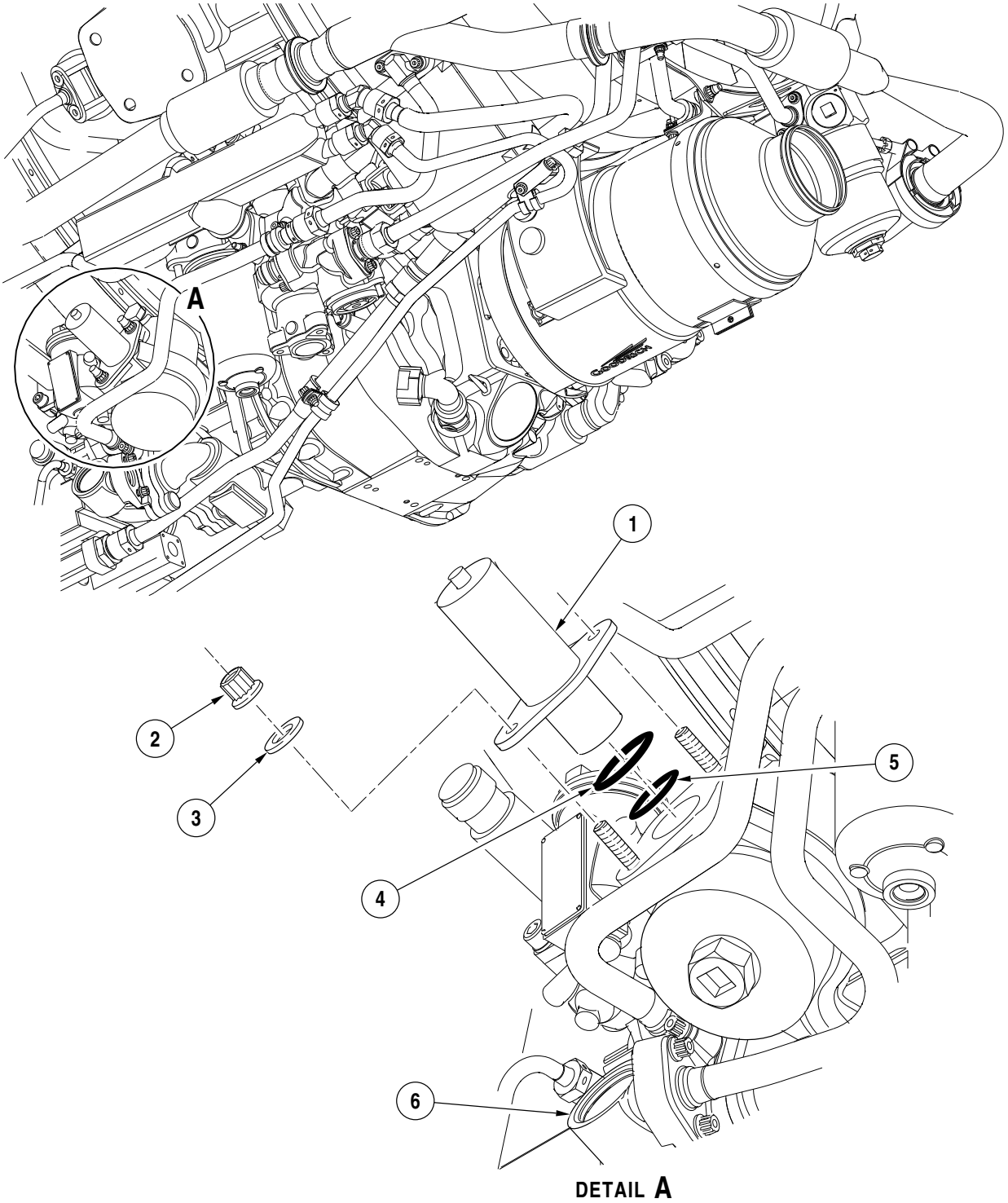
(1) Remove the protective covers and caps.

(2) Lubricate preformed packings (4) and (5) with a light film of engine oil (PWC03-001).

(3) Install new preformed packings (4) and (5) on the overtemperature popup indicator (1).

(4) Install the overtemperature popup indicator (1) on the fuel pump (6) with the washers (3) and the nuts (2). Torque the nuts (2) 75 to 85 lbf.in.

(5) If applicable, push in the button on the overtemperature popup indicator (1) until it is latches.



JT15D-5R Only

C110049

Removal/Installation - Overtemperature Popup Indicator
Figure 203

Key to Figure 203

1. Overtemperature Popup Indicator
2. Nut
3. Washer
4. Preformed Packing
5. Preformed Packing
6. Fuel Pump

7. Inspection/Check

A. Procedure

(1) For the JT15D-5: Inspect the fuel pump 74 micron inlet filter screen as follows:

(a) Remove inlet filter screen (Ref. Servicing).

(b) Clean the inlet filter screen (Ref. Para. 9., following) and examine for damage. Replace inlet filter screen if:

1 After repeated cleaning processes screen is not thoroughly clean.

2 There is evidence of broken strands.

3 Looseness or corrosion is present.

4 Any other damage is evident.

8. Adjustment/Test

Accomplish a functional check of fuel pump (Ref. 71-00-00, ADJUSTMENT/TEST).

9. Cleaning/Painting

A. Procedure

(1) For the JT15D-5: Clean the fuel pump 74 micron inlet filter screen as follows:

(a) Agitate screen in petroleum solvent (PWC11-027).

(b) Dry filter screen using clean, dry, filtered compressed air regulated to 15 psig.

(c) Repeat cleaning process if screen is not thoroughly clean.

FUEL TUBES, FDV TO FUEL MANIFOLD - DESCRIPTION AND OPERATION

1. Manifold Pressure Fuel Tubes

The manifold pressure fuel tubes are short, stainless steel transfer tubes housed in a fairing assembly between the inner and outer bypass ducts at the 6 o'clock position, engine rear. The transfer tubes link the primary and secondary pressure fuel tubes from the flow divider valve with the fuel inlet and shutoff valve assembly and direct fuel to the primary and secondary fuel manifolds.

FUEL TUBES, FDV TO FUEL MANIFOLD - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the FDV to fuel manifold pressure fuel tubes.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC11-027	Petroleum Solvent
PWC09-003C	Sealing Compound

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation (Heavy Maintenance Only)

   NOTE: Removal of the pressure fuel transfer tubes is normally required only when the LP turbine stator support assembly is removed for Hot Section Inspection (Ref. 72-40-01). The following procedures assume that the engine has been disassembled to the extent necessary to accomplish transfer tube removal.

   A. Removal of Primary and Secondary Pressure Fuel Transfer Tubes (Ref. Fig. 201)

      (1) Remove lockwire at elbows (4) and (3) of primary and secondary fuel tube (2) and (1) connections and disconnect tubes.

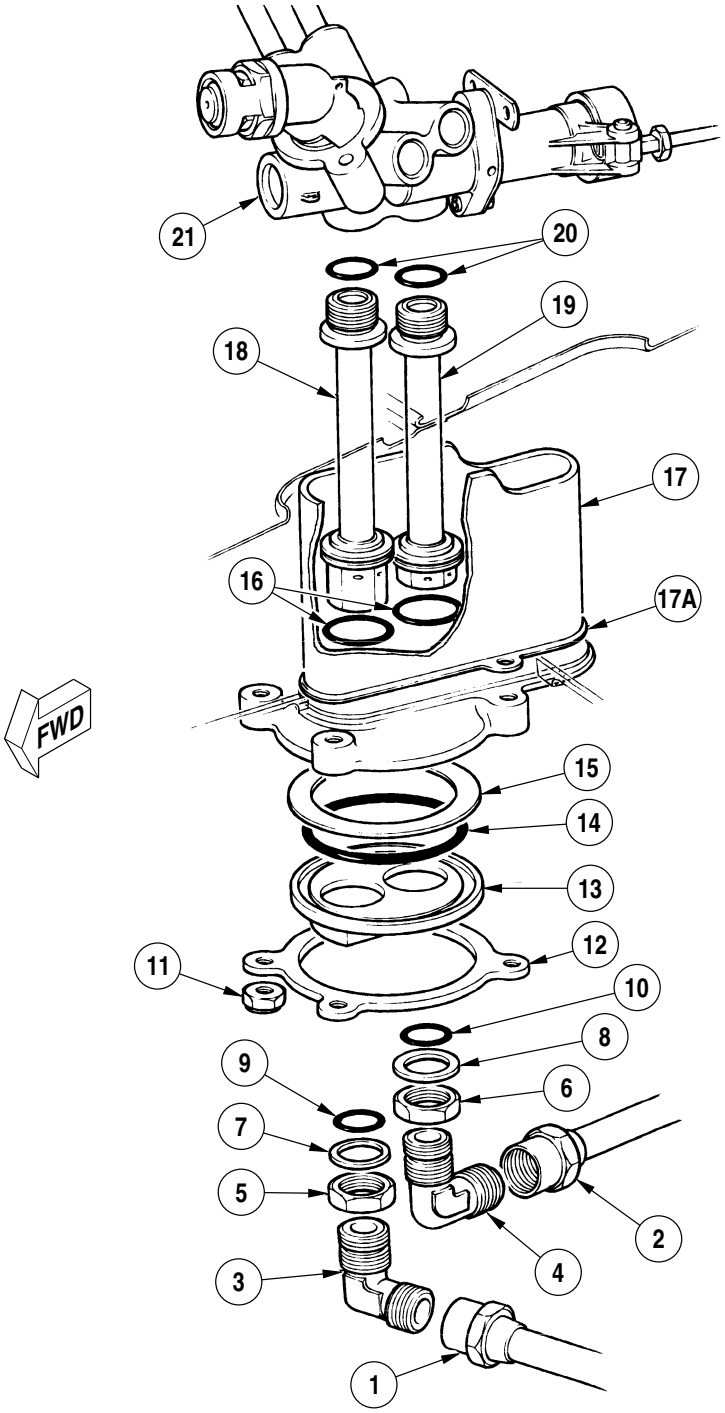
      (2) Slacken two nuts (5) and (6) and remove two elbows (3) and (4), two back-up rings (7) and (8), and two preformed packings (9) and (10). Discard packings. Primary line elbow (4) features a restrictor plug, normally left in situ.

      (3) Remove four self-locking nuts (11) securing fairing assembly (17) and remove fairing assembly parts (12), (13), (17A, JT15D-5 (Post-SB7222) and JT15D-5R), (15) and (17). Discard preformed packing (14) and gasket (17A).

      (4) Unscrew and remove primary and secondary fuel pressure tubes (18) and (19). Discard four preformed packings (16) and (20).

   B. Installation of Primary and Secondary Pressure Fuel Transfer Tubes (Ref. Fig. 201)

      (1) Install preformed packings (16) and (20) on primary and secondary fuel pressure tubes (19) and (18), respectively.



C12849A

Removal/Installation - Fuel Pressure Tubes, Flow Divider Valve to Fuel Manifold and Fairing Assembly
Figure 201

Key to Figure 201

1. Secondary Fuel Pressure Tube
2. Primary Fuel Pressure Tube
3. Elbow
4. Elbow
5. Nut
6. Nut
7. Backup Ring
8. Backup Ring
9. Preformed Packing
10. Preformed Packing
11. Self-locking Nut
12. Fairing Cover
13. Retainer
14. Preformed Packing
15. Inner Fairing Plate
16. Preformed Packing
17. Fuel Tubes Fairing Assembly
17A. Gasket, JT15D-5 (Post-SB7222) and JT15D-5R
18. Secondary Fuel Pressure Tube (to Manifold)
19. Primary Fuel Pressure Tube (to Manifold)
20. Preformed Packing
21. Fuel Inlet and Shutoff Valve Assembly

(2) Install secondary fuel pressure tube (18) (long tube) in front inlet port of fuel inlet and shutoff valve assembly (21) and primary fuel pressure tube (19) (short tube) in rear inlet port of housing. Tighten tubes and torque to 110 to 120 lb.in.

(3) Check clearances (REF. NO. 1109 and 1110, Table 201).

(4) Lightly smear lubricant (PWC09-003C)on mating faces of fuel pressure tube fairing assembly (17) and bypass duct deflector boss, then install fairing together with assembly parts (15), (17A, JT15D-5 (Post-SB7222) and JT15D-5R), (13) new preformed packing (14) and cover (12).

(5) Secure parts with four self-locking nuts (11). Tighten nuts and torque to 32 to 36 lb.in.

(6) Install elbows (3 and 4) using ancillary parts (5) through (10). and install elbows. Refer to Chapter 70-00-00, REMOVAL/INSTALLATION, for installation details. Do not exceed 42 lb.in. torque for smaller jam nut or 80 lb.in. for larger nut, when final-tightening these nuts.

NOTE: A restrictor plug in the primary line elbow (4) is normally not removed. Ensure plug is clean and free from obstructions.

(7) Secure primary pressure fuel tube (2), tighten and torque to 90 to 100 lb.in.

(8) Secure secondary pressure fuel tube (1), tighten and torque to 270 to 300 lb.in.

(9) Secure nuts with lockwire.

6. Inspection/Check

A. Inspect fuel pressure tube as follows:

(1) Scratches - Minor scratches having no appreciable depth are acceptable. Scratches to a depth of 0.005 inch must be blended out. Replace tube with scratches over 0.005 inch deep.

(2) Nicks - Individual nicks up to 0.062 inch long by 0.010 inch wide and 0.003 inch deep can be ignored. Nicks to a maximum depth of 0.005 inch must be blended out to remove sharp edges. Replace tube with nicks greater than 0.005 inch deep.

(3) Dents - Round bottomed dents on straight sections of tube are permitted provided the length and depth are not greater than 10 percent of the normal outside diameter of tube. No more than one dent to maximum depth per 12 inch length of tube is acceptable. Dents on tube bends, which cause restriction by flattening and local weakening, are not acceptable.

(4) Pitting - Minor isolated pitting up to 0.003 inch deep is acceptable. Clusters of pitting should be blended out to a maximum depth of 0.005 inch. Tube must be replaced if pitting exceeds 0.005 inch deep.

(5) Corrosion - Staining on tube and surface corrosion is acceptable, if removable by light polishing with crocus cloth and oil.

7. Cleaning/Painting

A. Clean pressure fuel tube as follows:

(1) Spray exterior of tube with petroleum solvent (PWC11-027) and clean using a soft bristle brush, as required Dry using compressed air, observing all normal ventilation and fire safety precautions.

(2) Clean tube interior by pressure flushing with petroleum solvent. Dry using clean, filtered compressed air, taking particular care that no foreign matter remains in tube.

(3) Cap tube ends immediately after cleaning and until tube is to be installed on engine to prevent entry of foreign matter.

8. Fits, Clearances and Torque Loadings

A. Refer to Table 201 and Figure 202.

TABLE 201, Fits and Clearances

REF. NO.	Name	Dim. for Ref. (inches) Min.	Dim. for Ref. (inches) Max.	Limits (inches) Min.	Limits (inches) Max.	Limits (inches) Replace
1109	Plate Inner, Fuel Pressure Tube Fairing	2.7210	2.7230	0.0000	0.0040T	
	Fairing, Fuel Pressure Tubes	2.7190	2.7210			
1110	Retainer, Packing, Fuel Pressure Tube Fairing (End Clearance) (with preformed packing removed)			0.0020	0.0100	

TABLE 202, Torque and Stretch

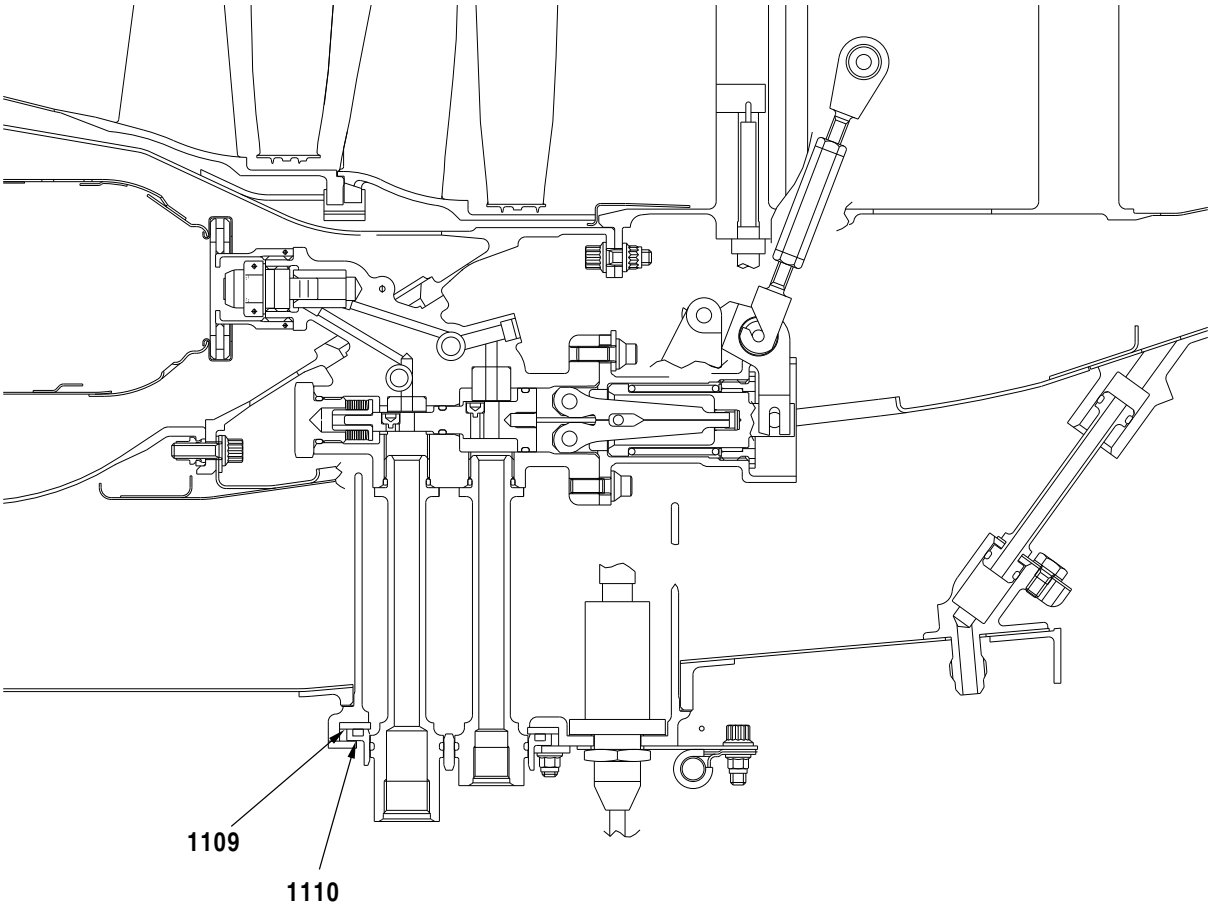
REF. NO.	Name	Limits Min.	Limits Max.
	Not Applicable		

TABLE 203, Spring Pressure

REF. NO.	Name	Limits Min.	Limits Max.
	Not Applicable		

TABLE 204, Special Assembly

REF. NO.	Name	Limits Min.	Limits Max.
	Not Applicable		



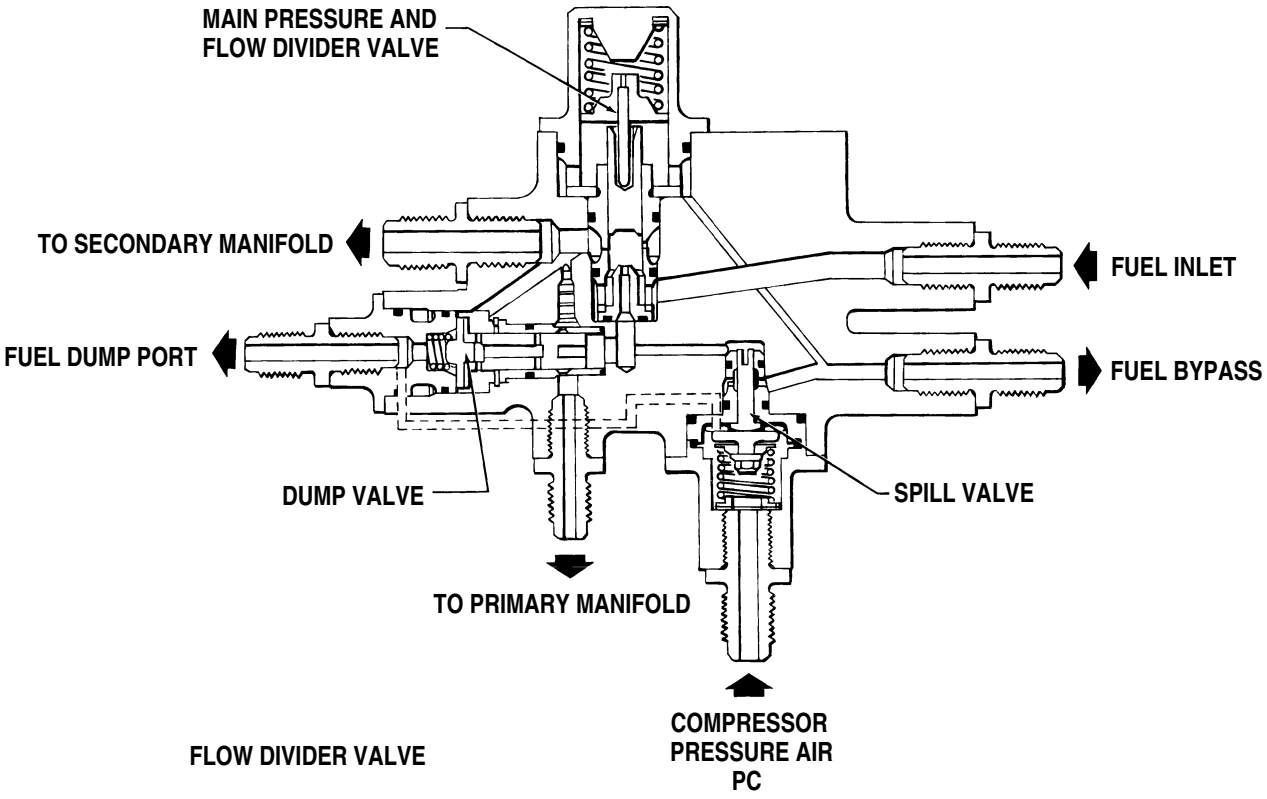
C34033

Fits, Clearances and Torque Loadings (Typical)
Figure 202

FLOW DIVIDER VALVE - DESCRIPTION AND OPERATION

1. Flow Divider Valve (Ref. Fig. 1)

The flow divider valve (FDV) divides the metered flow between the primary and secondary manifolds as a scheduled function of primary fuel pressure. It also provides the minimum back pressure on the fuel control which is required for proper metering head regulation. A dump valve, sensitive to primary manifold flow, serves to drain both manifolds overboard after shutdown. A starting pressure regulator is included which limits the primary manifold fuel pressure during light-off and acceleration to idle, as a function of compressor pressure rise. The excess flow is spilled to bypass. This function provides the optimum starting fuel schedule which cannot be readily accomplished in the simple mechanics of the HMU. A cross-manifold bleed keeps the secondary fuel manifold full and provides smooth engine handling.



C10751

Flow Divider Valve
Figure 1

FLOW DIVIDER VALVE - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the flow divider valve.

2. Consumable Materials

   Not Applicable

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal of Flow Divider Valve (FDV) (Ref. Fig. 201)

      (1) Disconnect P3 air tube connector (8) from elbow (9) on FDV (4).

      (2) Disconnect fuel tubes (1), (5) and (7) from flow divider valve.

      (3) Disconnect air pressure delivery tube (2) from elbow on FDV.

      (4) Remove four bolts (12) and washers (13) securing flow divider (4) to mounting bracket (6) and withdraw FDV.

      (5) Install protective plugs and store FDV in a suitable container.

   B. Installation of Flow Divider Valve (Ref. Fig. 201)

      (1) Check riveted locknuts on flow divider valve mounting bracket (6) for security and condition. Replace if necessary.

      (2) Remove all protective caps and plugs.

      (3) Position flow divider valve (4) on bracket (6) and secure with four washers (13) and bolts (12). Tighten bolts and torque to 75 to 85 lb.in.

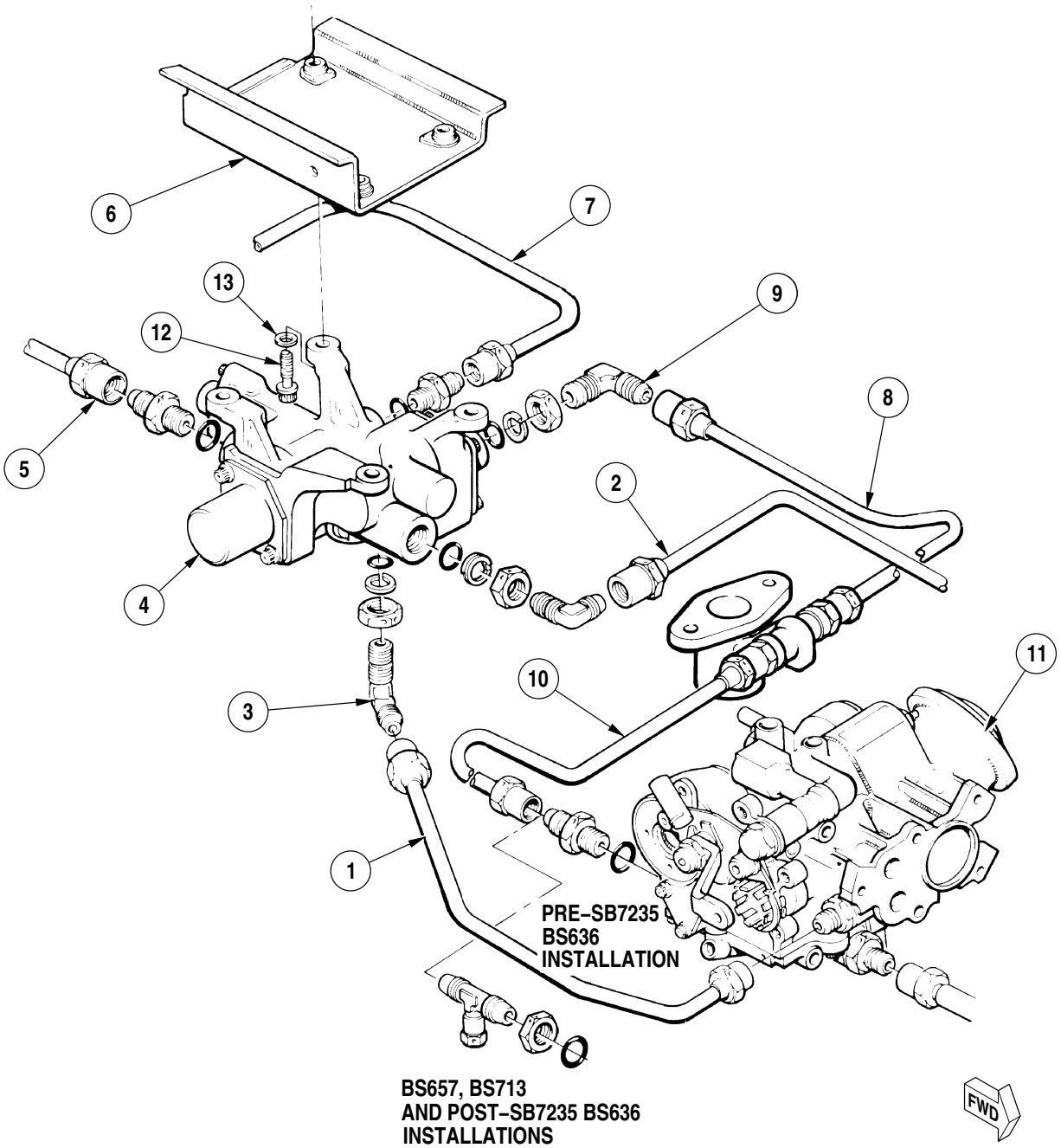
      (4) Connect P3 air tube (8) to elbow (9) on FDV. Torque tube coupling nut 270 to 300 lb.in.

      (5) Connect air pressure delivery tube (2) to elbow on FDV.

      (6) Connect fuel tubes (1), (5) and (7) to FDV.

         (a) Tighten and torque tube (1) and (7) connectors to 90 to 100 lb.in.

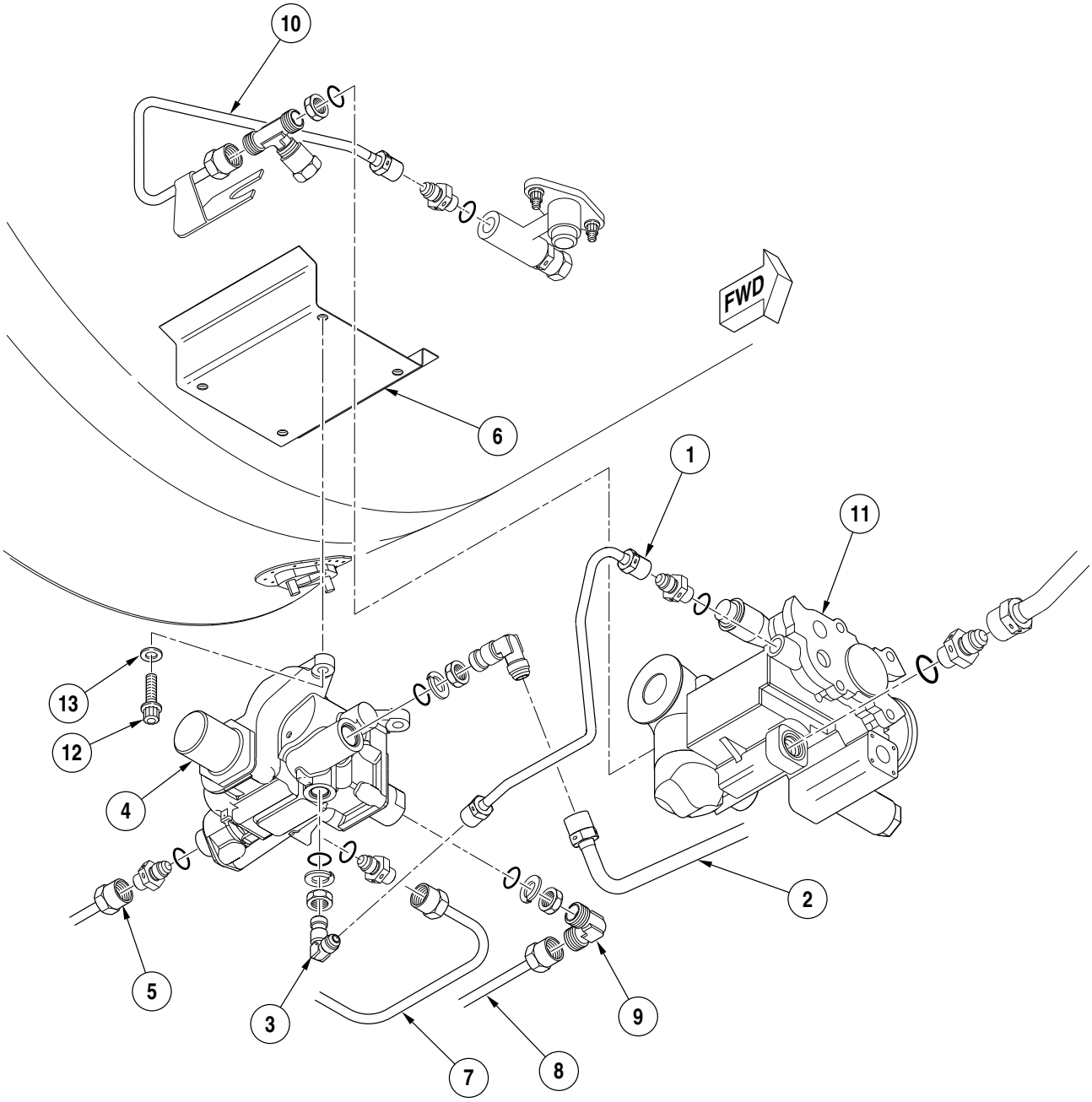
         (b) Tighten and torque tube (2) and (5) connectors to 270 to 300 lb.in.



JT15D-5 Only

C11563C

Removal/Installation - Flow Divider Valve
Figure 201 (Sheet 1 of 2)



JT15D-5R Only

C108839

Removal/Installation - Flow Divider Valve
Figure 201 (Sheet 2)

Key to Figure 201

1. Bypass Fuel Tube
2. Metered Fuel to FDV Tube
3. Elbow
4. Flow Divider Valve
5. Secondary Fuel Tube
6. Mount Bracket (FDV)
7. Primary Fuel Tube
8. Compressor Air (P3) Delivery Tube
9. Elbow
10. P3 Air to HMU Tube
11. Hydromechanical Metering Unit (HMU)
12. Bolt
13. Washer

(7) Lockwire all connections.

FUEL MANIFOLD ASSEMBLY - DESCRIPTION AND OPERATION

1. Description

A. Fuel Manifold (Ref. Fig. 1)

The fuel manifold delivers metered fuel from the flow divider valve to the primary and secondary passages in the 12 dual orifice-type fuel nozzles. The manifold consists of 12 adapter assemblies, one of which is an inlet adapter, interconnected by transfer tubes and secured to their respective bosses in the low pressure turbine stator support assembly by two bolts. The pairs of external transfer tubes are secured by locking brackets to maintain their location, and the tubes are sealed with preformed packings. The inlet adapter incorporates an integral section which houses components of an automatic fuel shut-off valve.

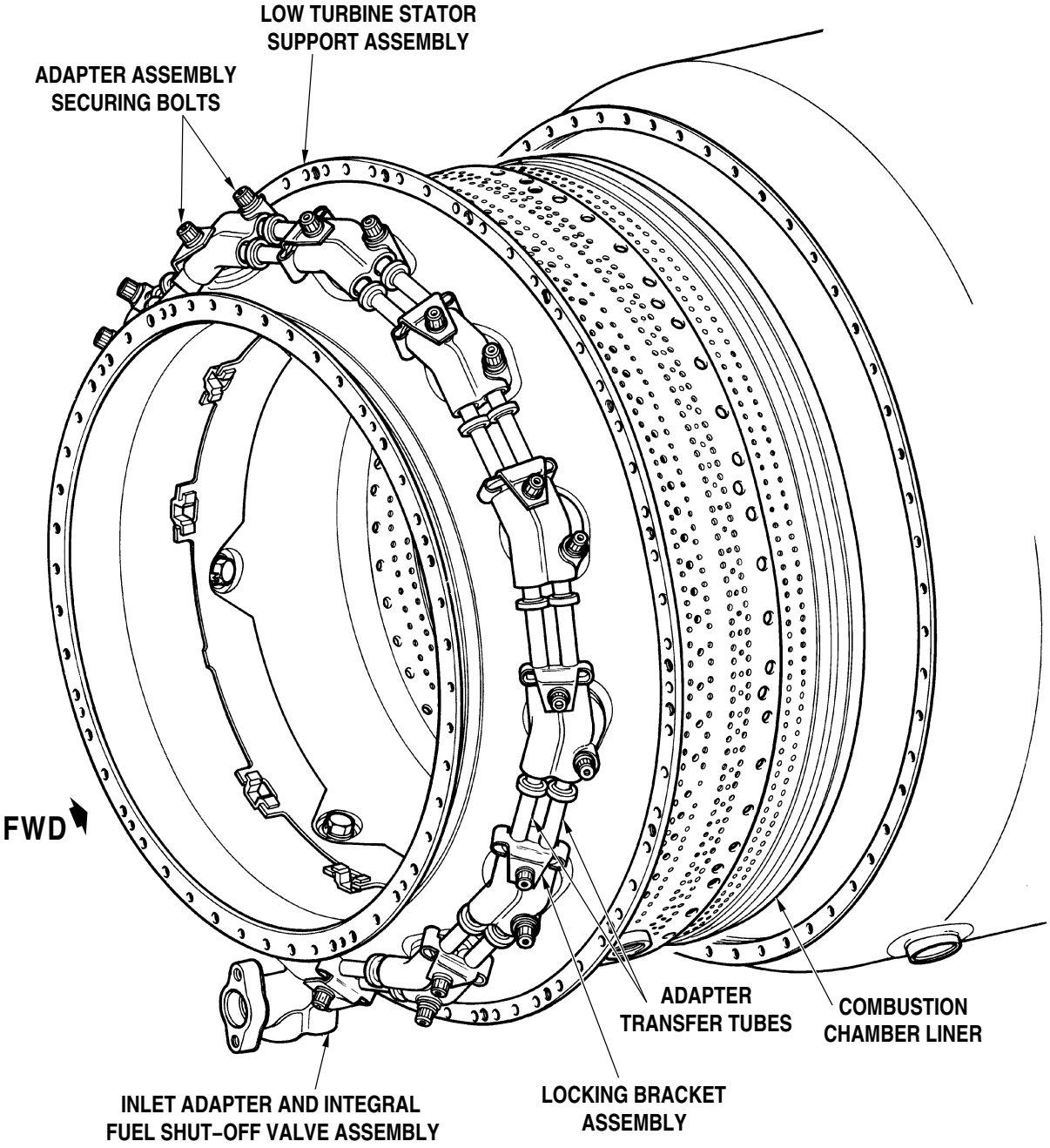
B. Fuel Manifold Adapter Assemblies (Ref. Figs. 1 and 2)

Each fuel manifold adapter houses a dual orifice fuel nozzle. On JT15D-5 (Pre-SB7493 and Pre-SB7493) engines a removable sheath surrounds the orifice. JT15D-5 (Post-SB7493 and Post-SB7526) and JT15D-5R nozzle assemblies incorporate an integral swirler assembly around the nozzle orifice. The nozzles are threaded and have lockwire holes so that they can be tightly secured to the adapters. Passages connect the nozzle to its respective primary and secondary bores in the adapter body. The manifold adapters project the nozzle assemblies through the low pressure turbine stator support assembly into the combustion chamber liner. The single fuel inlet manifold adapter is also secured to the fuel inlet and emergency fuel shut-off valve housing assembly (Ref. Chapter 73-10-11).

C. Fuel Nozzles (Ref. Fig. 2)

JT15D-5 (Pre-SB7493 and Pre-SB7526) engines: the dual orifice fuel nozzle has a swirl-type tip, and a separate sheath. The nozzle distributor has two offset slots to impart a swirl motion to the fuel which emerges as a finely atomized spray in the combustion chamber. Each fuel nozzle incorporates separate primary and secondary passage screens. Passages connect the nozzle to its respective primary and secondary bores in the adapter body. The sheath and nozzle extend through the LP turbine stator support assembly into the combustion chamber liner. Slots in the sheath allow compressor discharge air to pass through the sheath and over the nozzle tip, assisting in atomizing the fuel.

JT15D-5 (Post-SB7493/Post-SB7526) and JT15D-5R engines: each fuel nozzle assembly consists of an assembled secondary swirler assembly, seal, primary stem assembly thatv incorporates a filter, metering ring, secondary strainer, spacer, shim(s), and a bowed internal retaining ring. The nozzle assembly supplies fuel to it's own spray tip via fuel passages in the primary stem assembly and secondary swirler assembly. The primary stem assembly and secondary swirler assembly area are secured to one another with a seal. A bowed internal retaining ring secures the shim(s), spacer, secondary strainer and metering ring. Each fuel nozzle incorporates separate primary and secondary passage screens to prevent contaminants from entering the spray tip. The primary and secondary orifices are adjusted at manufacture to provide the proper fuel flow to the spray pattern. The nozzle incorporates two separate sets of passages for swirling compressor discharge air to assist in atomizing the primary and secondary fuel flows.



C11482

Fuel Manifold Assembly
Figure 1

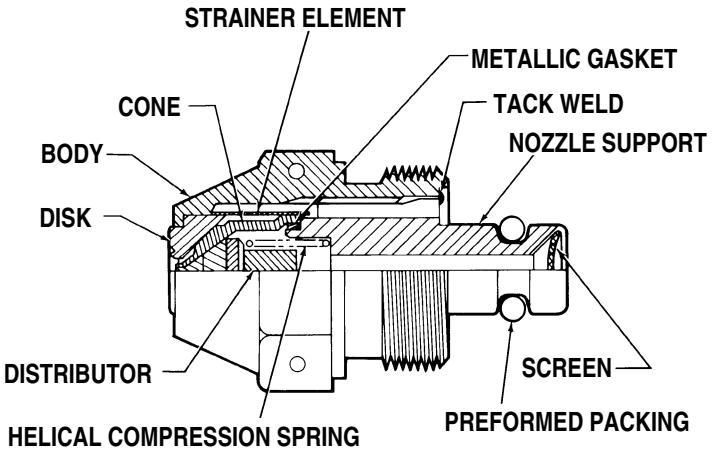
Surrounding the tip of the nozzle at its outer diameter is an integral swirler assembly incorporating vanes through which compressor air delivers a swirling motion to primary and secondary fuel flows. Additionally, six drilled holes around the circumference of the nozzle supply compressor discharge air to surround the nozzle's primary orifice.

JT15D-5 (Post-SB7598) and JT15D-5R engines have a heat shield around the primary fuel distributor to decrease the heat transfer to the fuel inside the nozzle tip. The fuel nozzle housing is also improved to decrease the transfer of heat to the fuel. This helps to keep the formation of carbon to a minimum.

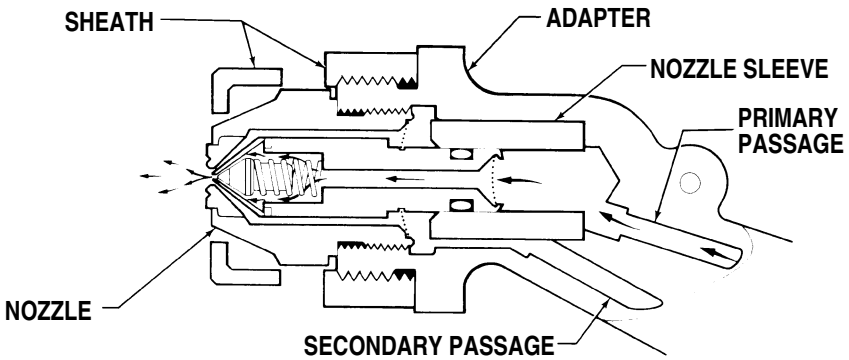
2. Operation (Ref. Fig. 2)

JT15D-5 (Pre-SB7493 and Pre-SB7526) engines: fuel is supplied at fuel pump pressure to the fuel nozzle primary circuit during starting fuel flow,and is routed through an integral wire screen to the distibutor. The nozzle distributor has two offset slots to impart a swirling motion to the fuel which emerges as a finely atomized spray in the combustion chamber. As engine N2 rpm increases, fuel from the secondary circuit is supplied to the nozzle's secondary passages. The secondary fuel flow mixes with the primary fuel flow at the nozzle orifice where high velocity compressor air, captured and directed by the fuel nozzle sheath, atomizes the fuel and propels it into the combustion chamber liner.

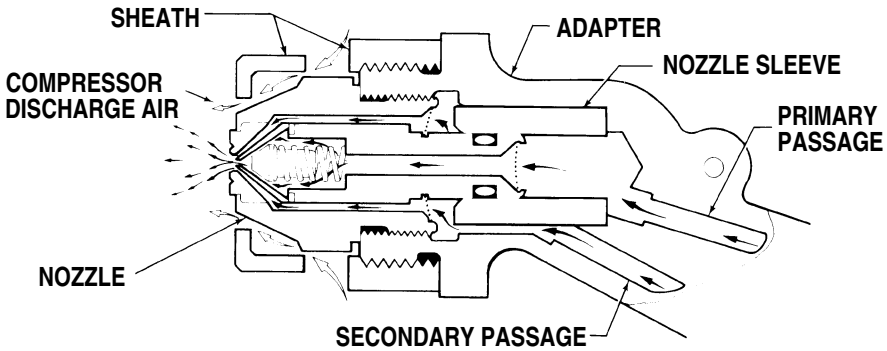
JT15D-5 (Post-SB7493/Post-SB7526) and JT15D-5R engines: fuel is supplied at fuel pump pressure to the primary circuit of the primary stem assembly. The fuel is routed through a strainer to the stem distributor. It passes through the metered distributor and into the spin passage of the primary cone where it emerges as a conical sheet and is hit with swirling high velocity air which shreds the fuel sheet and breaks it up into droplets.The nozzle secondary passage is supplied under pressure to the secondary circuit where it is routed through a strainer and metering ring, through internal passages to the secondary swirler assembly. The fuel travels through the secondary fuel swirler passages, where it is spun in a swirling motion. The secondary fuel then moves toward the exit annulus where it emerges as a conical sheet and is hit with swirling high velocity compressor delivery air which shreds the fuel sheet and breaks it up into droplets. Two separate sets of compressor air passages deliver separate, counter-rotating layers of swirling air so that primary and secondary fuel flow emerges as a finely atomized spray in the combustion chamber.



TYPICAL NOZZLE ASSEMBLY



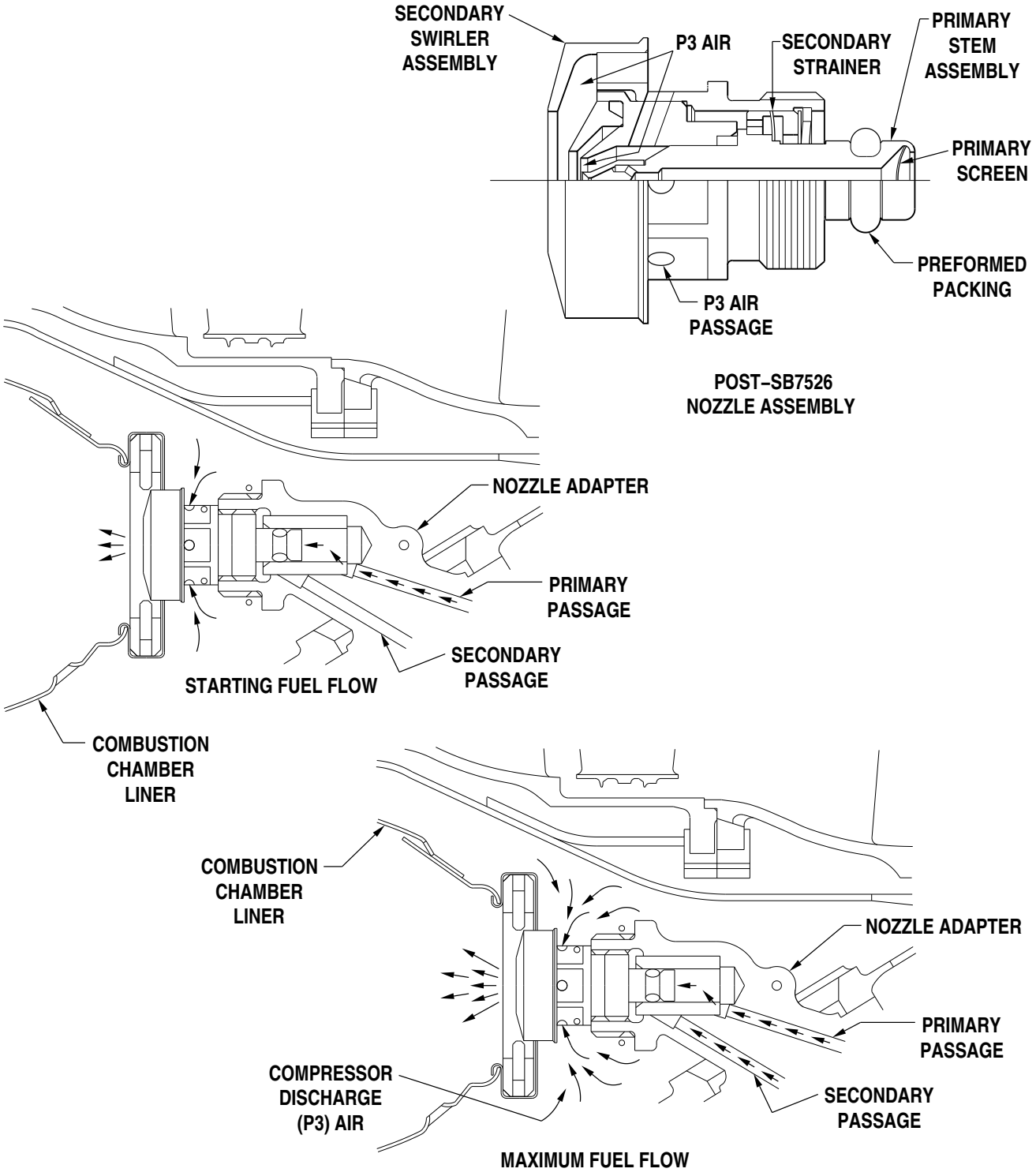
STARTING FUEL FLOW



MAXIMUM FUEL FLOW

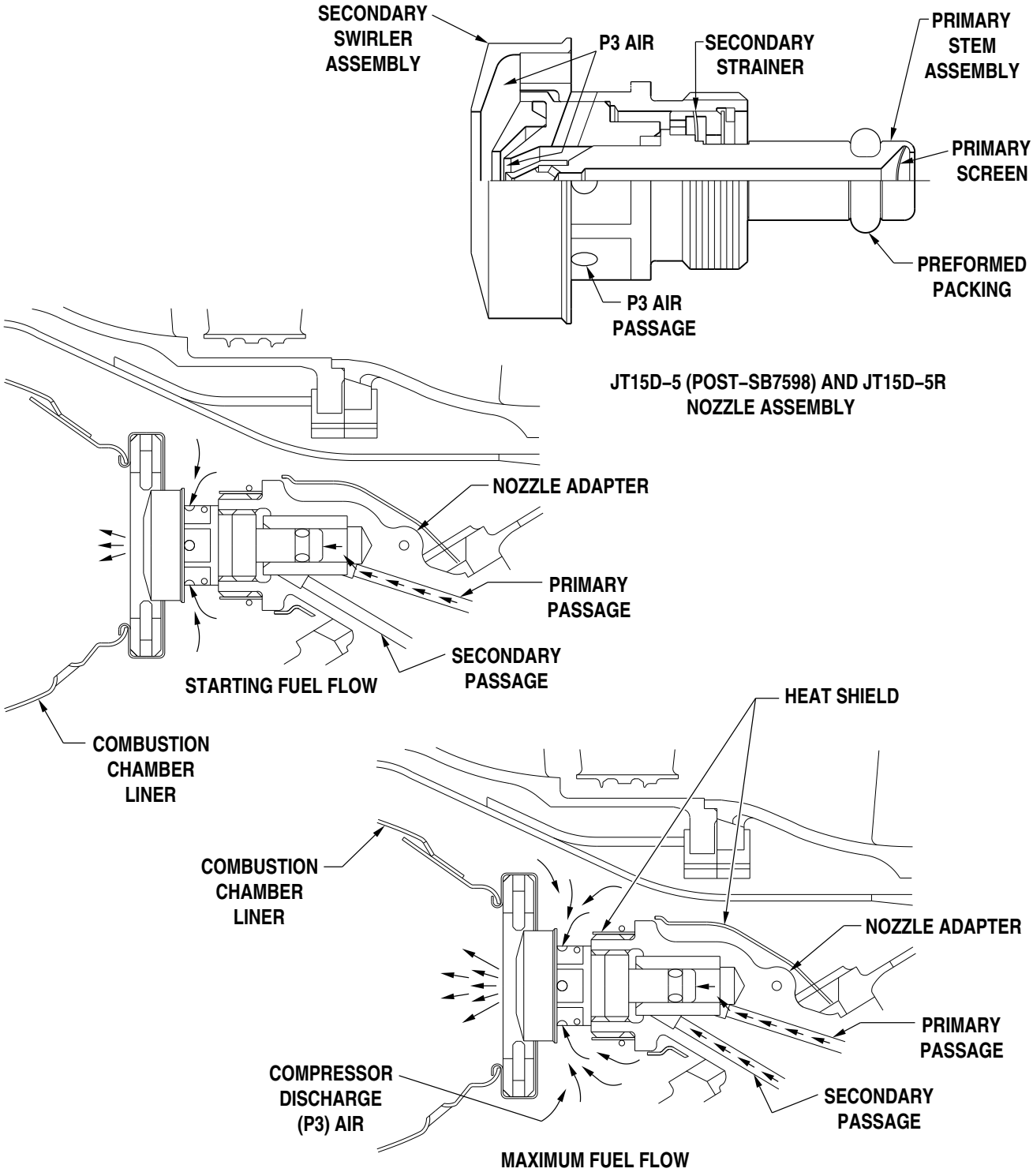
JT15D-5 (PRE-SB7493/ PRE-SB7526) C12290

Fuel Nozzle Assembly and Operation (Schematic)
Figure 2 (Sheet 1 of 3)



JT15D-5 (POST-SB7493/ POST-SB7526) C70160

Fuel Nozzle Assembly and Operation (Schematic)
Figure 2 (Sheet 2)



JT15D-5 (POST-SB7598) AND JT15D-5R C108825

Fuel Nozzle Assembly and Operation (Schematic)
Figure 2 (Sheet 3)

FUEL MANIFOLD ASSEMBLY - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the fuel manifold assembly.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC01-001	Engine Fuel
PWC03-001	Engine Lubricating Oil
PWC05-050	Nitrogen (Technical Grade)
PWC06-004A	Anti-seize Compound
PWC09-005	Universal Joining Compound
PWC11-027	Petroleum Solvent

3. Special Tools

   The special tools listed below are used in the following procedures.

Tool No.	Name	Application
PWC31031	Fixture	
PWC31073-01	Fitting	
PWC31073-02	Fitting	
PWC31086	Test Rig	
PWC31261	Blanking Plug	
PWC31263	Blanking Cap	
PWC52294	Wrench	
PWC52509	Cap-off Tool	
PWC52693	Plug, Leakage Check, Post-SB7598 Fuel Manifold Inlet Adapter	Secondary Inlet Port
PWC52701	Plug, Leakage Check, Post-SB7598 Fuel Nozzle Inlet Adapter	Primary Inlet Port

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

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5. Removal/Installation

As combustion chamber liner removal allows inspection and testing of fuel nozzles while installed, it is recommended that the following disassembly procedures be carried out only for troubleshooting or when specific nozzle adapter assemblies are to be replaced. Clean and inspect fuel nozzles as indicated (Ref. Para.7., Cleaning and Para.8., Inspection. Nozzles which fail to meet the inspection criteria may be replaced individually.

The following procedures assume the LP turbine stator support assembly has been removed and separated from the combustion chamber liner (Ref. 72-40-01).

A. Removal of Fuel Manifold Assembly (Ref. Fig. 201)

CAUTION: PLACE FUEL NOZZLE ADAPTER ASSEMBLIES IN PROTECTIVE CONTAINERS TO PREVENT EXPOSURE TO DIRT AND DUST.

(1) Using an approved temporary method (Ref. 70-00-00, STANDARD PRACTICES), mark fuel manifold adapters with position before removal, to ensure reinstallation in original locations.

(2) Remove two attaching bolts (8), (9) and locking bracket (7) from fuel inlet and shut-off valve housing assembly (3), and two adjacent fuel manifold adapters (4).

(3) Push two transfer tubes (6) into and pull two transfer tubes out of opposite sides of fuel inlet and shut-off valve housing assembly (3), then remove assembly.

(4) Remove two bolts (8), (9) and locking bracket (7) from each of remaining fuel manifold adapters (4).

(5) Push remaining fuel transfer tubes (6) into adapters (4), then remove adapters with tubes from LP turbine support assembly (1).

(6) Remove transfer tubes (6) from adapters (4) and remove and discard all preformed packings (5).

(7) JT15D-5 (Pre-SB7493) engines: remove fuel nozzle sheaths (2).

(8) If fuel nozzle assemblies are to be removed from fuel manifold adapters in accordance with HSI recommendation (Ref. 72-00-00, Hot Section Inspection), refer to nozzle removal and installation procedures in Paragraph 9., Approved Repairs. Nozzle assemblies can be removed without removing adapters.

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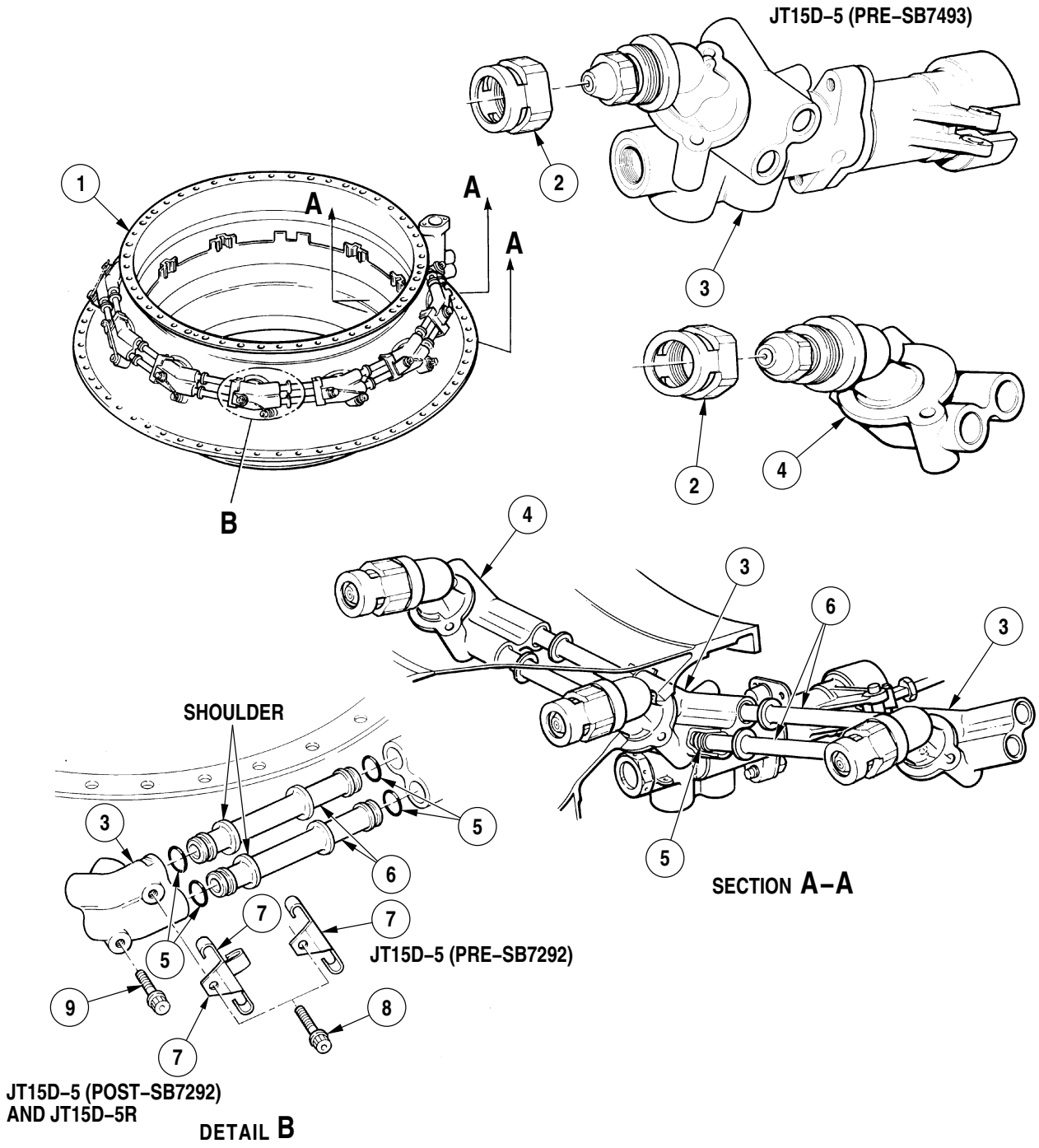

C38599C

Removal/Installation - Fuel Manifold Assembly
Figure 201 (Sheet 1 of 3)

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Key to Figure 201

1. LP Turbine Stator Support Assembly
2. Fuel Nozzle Sheath , JT15D-5 (Pre-SB7493)
3. Fuel Inlet/Shut-off Valve Assembly
4. Fuel Manifold Adapter
5. Preformed Packing
6. Transfer Tube
7. Fuel Manifold Transfer Tube Locking Bracket
8. Bolt
9. Bolt

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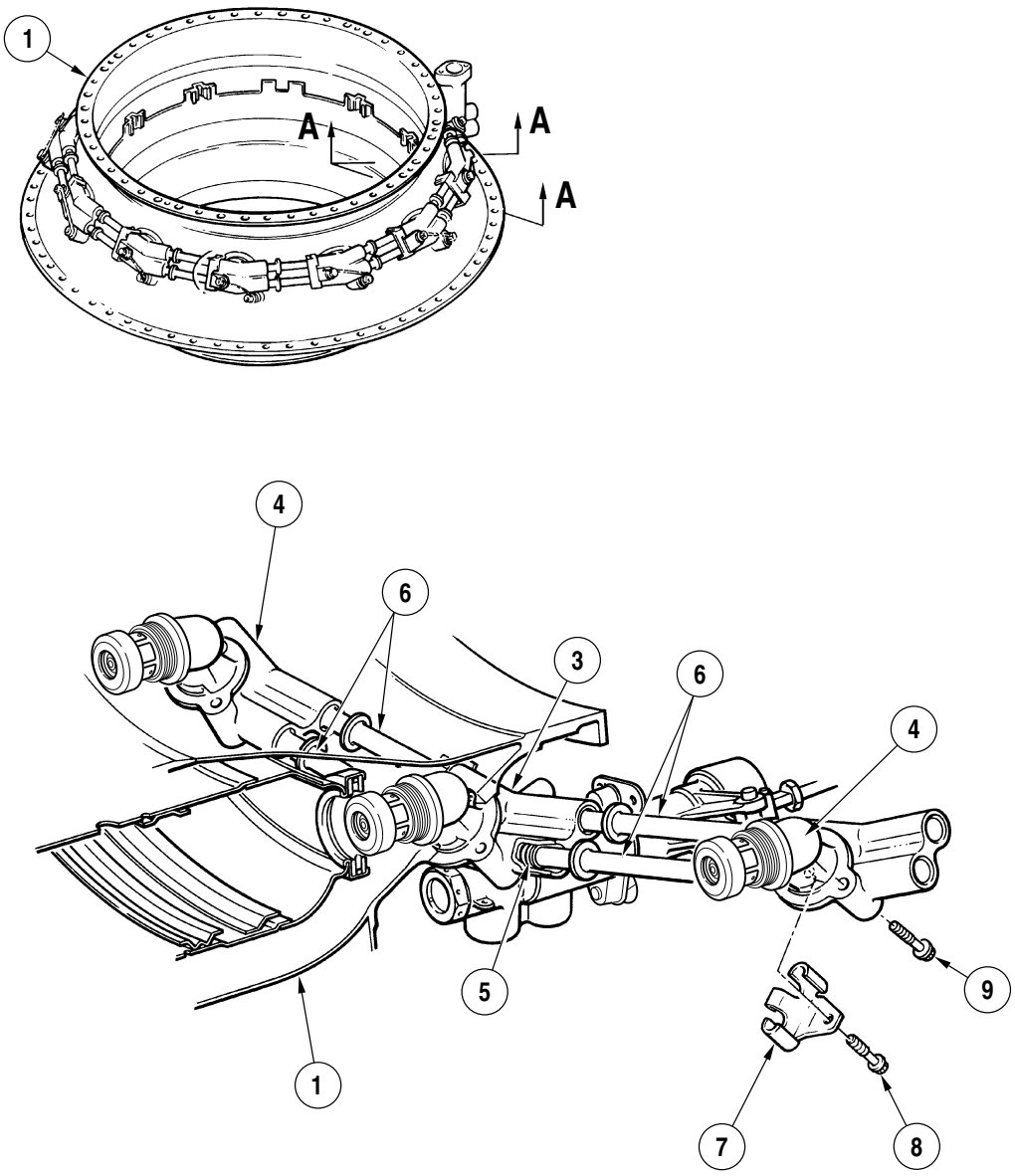

SECTION A–A

JT15D-5 (POST-SB7493/POST-SB7526) C38598B

Removal/Installation - Fuel Manifold Assembly
Figure 201 (Sheet 2)

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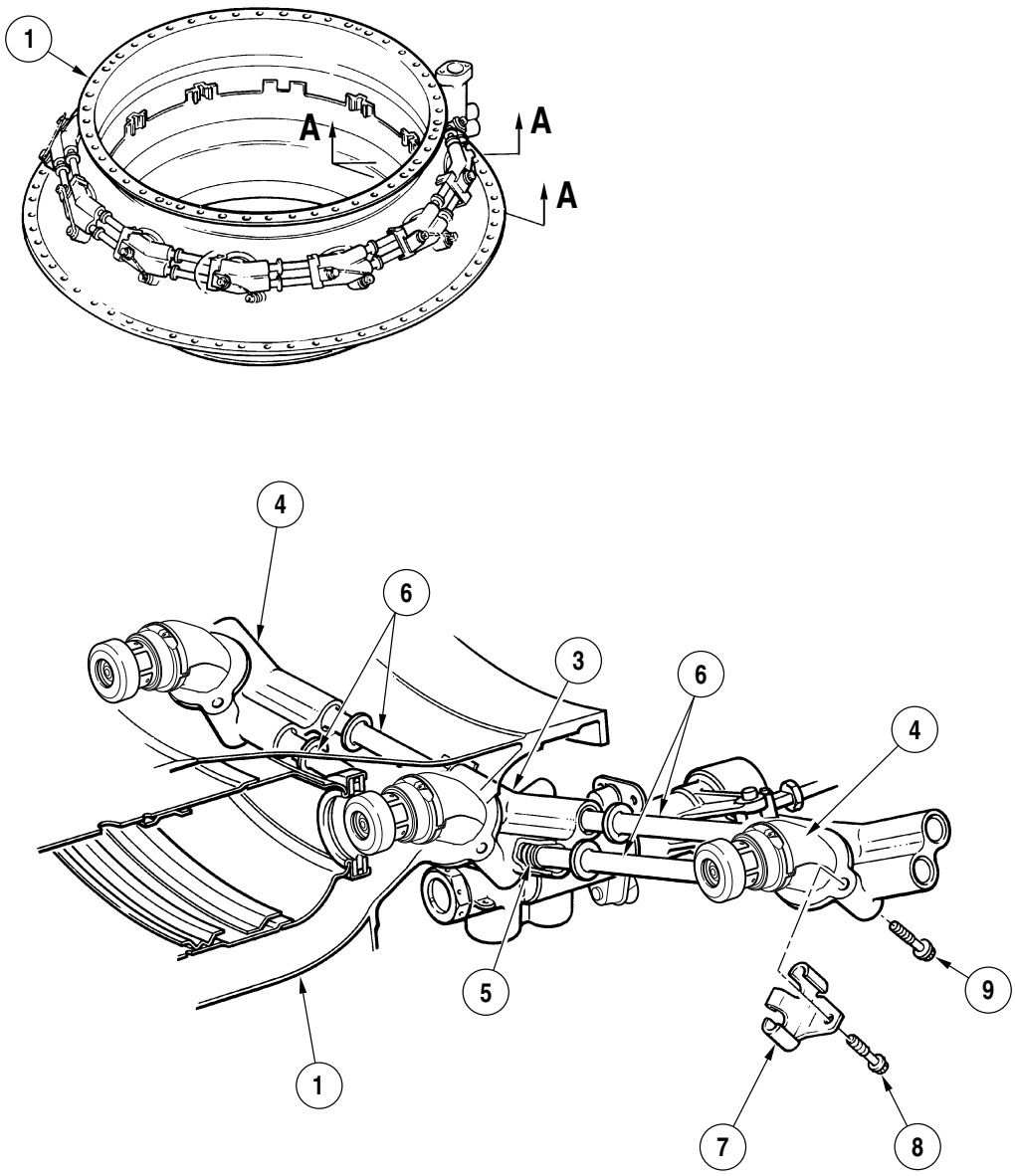

SECTION **A–A**

JT15D-5 (POST-SB7598) AND JT15D-5R NOZZLE/ADAPTER C96916

Removal/Installation - Fuel Manifold Assembly
Figure 201 (Sheet 3)

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B. Installation of Fuel Manifold Assembly (Ref. Fig. 201)

CAUTION: TAKE EXTREME CARE DURING REMOVAL/INSTALLATION TO ENSURE THAT DIRT AND/OR OTHER FOREIGN MATTER DOES NOT CONTAMINATE FUEL MANIFOLD SYSTEM AND NOZZLE. USE CLEAN, LINT-FREE COTTON GLOVES, OR SURGICAL GLOVES, AS SKIN CONTACT WITH THE NOZZLE ORIFICE AND/OR FILMING SURFACE MAY PRODUCE A POOR SPRAY PATTERN.

NOTE: Install fuel manifold assembly before installing combustion chamber liner to facilitate fuel manifold pressure check (Ref. Para. 6.C.).

(1) JT15D-5 (Pre-SB7493) engines: Install fuel nozzle sheaths (2) on nozzle adapters (3) and (4), then tighten and torque (REF. NO. 1712, Table 202).

(2) Lubricate 48 new preformed packings (5) with engine oil (PWC03-001) and install on 24 transfer tubes (6).

NOTE: Use only specified lubricant on preformed packings.

(3) Clean off mating faces on all nozzle adapters (3) and (4) and LP turbine stator support assembly (1) housings and apply an even coating of sealing compound (PWC09-005).

(4) With small Flange D on LP turbine stator support assembly (1) facing up, install transfer tubes (6) and nozzle adapter assemblies (3) and (4) in clockwise progression, as follows:

(a) Install fuel inlet and shut-off valve housing assembly (3) in original location at 6 o'clock position. Attach with one bolt (9) but do not torque at this stage.

(b) Insert long ends of two transfer tubes (6), with stop flange farthest from edge, into fuel inlet and shut-off valve housing assembly and into each of the 11 fuel manifold adapters (4). Push tubes until stop flanges contact sides of housing and adapters.

(c) Install appropriate numbered fuel manifold adapter (4) adjacent to inlet housing and secure with one bolt (10).

(d) Pull transfer tubes (6) from fuel inlet and shut-off valve housing to facilitate insertion in holes of adjacent fuel manifold adapter. Stop flanges on short ends must contact side of fuel manifold adapter.

CAUTION: TO PREVENT REMOVAL OF TRANSFER TUBES, ENSURE THAT ALL LOCKING BRACKETS ARE CORRECTLY LOCATED BEHIND TRANSFER TUBE FLANGES. BRACKETS MUST BE CLEAR OF TUBES BY APPROXIMATELY 0.030 INCH TO AVOID FRETTING WEAR.

(e) Install locking bracket (7) with second bolt (8) on fuel manifold adapter (4).

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TEMPORARY REVISION NO. 73-3

(JT15D-5, JT15D-5R)

INSERT Temporary Revision 73-3 facing page 207, Chapter 73-10-05

FUEL MANIFOLD ASSEMBLY - MAINTENANCE PRACTICES

PURPOSE: The purpose of this temporary revision is to add a graphic for installation of transfer tubes in the fuel manifold assembly.

B. Installation of Fuel Manifold Assembly (Ref. Fig. 201 & 201A)

CAUTION: TAKE EXTREME CARE DURING REMOVAL/INSTALLATION TO ENSURE THAT DIRT AND/OR OTHER FOREIGN MATTER DOES NOT CONTAMINATE FUEL MANIFOLD SYSTEM AND NOZZLE. USE CLEAN, LINT-FREE COTTON GLOVES, OR SURGICAL GLOVES, AS SKIN CONTACT WITH THE NOZZLE ORIFICE AND/OR FILMING SURFACE MAY PRODUCE A POOR SPRAY PATTERN.

NOTE: Install fuel manifold assembly before installing combustion chamber liner to facilitate fuel manifold pressure check (Ref. Para. 6.C.).

(1) JT15D-5 (Pre-SB7493) engines: Install fuel nozzle sheaths (2) on nozzle adapters (3) and (4), then tighten and torque (REF. NO. 1712, Table 202).

(2) Lubricate 48 new preformed packings (5) with engine oil (PWC03-001) and install on 24 transfer tubes (6).

NOTE: Use only specified lubricant on preformed packings.

(3) Clean off mating faces on all nozzle adapters (3) and (4) and LP turbine stator support assembly (1) housings and apply an even coating of sealing compound (PWC09-005).

(4) With small Flange D on LP turbine stator support assembly (1) facing up, install transfer tubes (6) and nozzle adapter assemblies (3) and (4) in clockwise progression, as follows:

(a) Install fuel inlet and shut-off valve housing assembly (3) in original location at 6 o'clock position. Attach with one bolt (9) but do not torque at this stage.

(b) Insert long ends of two transfer tubes (6), with stop flange farthest from edge, into fuel inlet and shut-off valve housing assembly and into each of the 11 fuel manifold adapters (4). Push tubes until stop flanges contact sides of housing and adapters.

(c) Install appropriate numbered fuel manifold adapter (4) adjacent to inlet housing and secure with one bolt (10).

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(d) Pull transfer tubes (6) from fuel inlet and shut-off valve housing to facilitate insertion in holes of adjacent fuel manifold adapter. Stop flanges on short ends must contact side of fuel manifold adapter.

CAUTION: TO PREVENT REMOVAL OF TRANSFER TUBES (REF. FIG. 201A), MAKE SURE THAT ALL LOCKING BRACKETS ARE CORRECTLY LOCATED BEHIND TRANSFER TUBE FLANGES. BRACKETS MUST BE CLEAR OF TUBES BY APPROXIMATELY 0.030 INCH TO PREVENT FRETTING WEAR.

(e) Install locking bracket (7) with second bolt (8) on fuel manifold adapter (4).

(f) Install next fuel manifold adapter (3), transfer tubes (6) and locking brackets (7) or (9) in clockwise direction using method described in step (d), preceding, connect transfer tubes and repeat step (e), preceding. Repeat procedure for remaining nine fuel manifold adapters.

(g) Install remaining locking bracket (7) and bolt (8) on fuel inlet and shut-off valve housing assembly (3).

(h) Tighten all bolts and torque 24 to 36 lb.in., but do not lockwire at this stage.

(i) Remove excess sealing compound (PWC09-005).

(j) Accomplish a fuel manifold pressure check as described in Para. 6.C., following. When satisfactory, lockwire all bolts, connections and, for JT15D-5 (Pre-SB7493) engines, fuel nozzle sheaths (2).

(k) If one or more fuel nozzles were replaced, perform required ground checks (Ref. 71-00-00, ADJUSTMENT/TEST).

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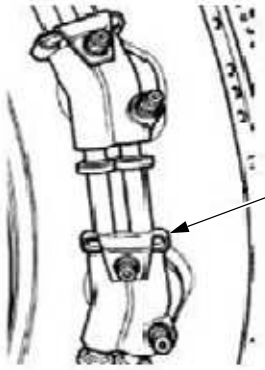
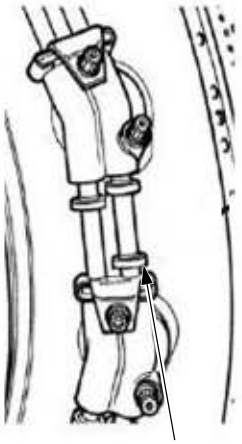
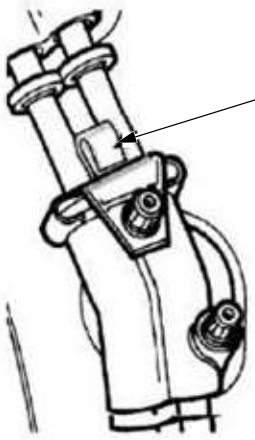


PRE–SB7292
CORRECT ASSEMBLY
TUBES ARE LOCKED



PRE–SB7292
INCORRECT ASSEMBLY
ONE TUBE IS NOT LOCKED



POST–SB7292
TANG PREVENTS INCORRECT
TUBE ASSEMBLY

ICN-00198-G000000462-001-01

Installation of Transfer tubes in the Fuel manifold assembly
Figure 201A

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(f) Install next fuel manifold adapter (3), transfer tubes (6) and locking brackets (7) or (9) in clockwise direction using method described in step (d), preceding, connect transfer tubes and repeat step (e), preceding. Repeat procedure for remaining nine fuel manifold adapters.

(g) Install remaining locking bracket (7) and bolt (8) on fuel inlet and shut-off valve housing assembly (3).

(h) Tighten all bolts and torque 24 to 36 lb.in., but do not lockwire at this stage.

(i) Remove excess sealing compound (PWC09-005).

(j) Accomplish a fuel manifold pressure check as described in Para. 6.C., following. When satisfactory, lockwire all bolts, connections and, for JT15D-5 (Pre-SB7493) engines, fuel nozzle sheaths (2).

(k) If one or more fuel nozzles were replaced, perform required ground checks (Ref. 71-00-00, ADJUSTMENT/TEST).

6. Adjustment/Test

A. General

Fuel nozzles may be inspected and if applicable cleaned, without being removed from the LP turbine stator support assembly, if the combustion chamber liner is removed.

If it is necessary to remove any fuel manifold nozzle adapter assembly as a result of unsatisfactory functioning or for other cause, a functional test must be accomplished before reinstallation and the fuel manifold must be pressure tested after installation of a new or repaired adapter assembly.

Functional tests may be accomplished on fuel manifold nozzle adapters installed in the LP turbine stator support assembly, or on individual uninstalled fuel manifold nozzle adapter assemblies.

Nozzles rejected when subjected to functional tests may be individually replaced, or replacement fuel manifold nozzle adapter assemblies may be installed. In either case a manifold pressure check (Ref. Para. 6.C.) must be effected and a ground run must be accomplished (Ref. 71-00-00, ADJUSTMENT/TEST).

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B. Functional Test of Fuel Manifold Nozzle Adapters (Ref. Fig. 203)

CAUTION: MAKE SURE THAT ALL THE FUEL NOZZLE CAPPING TOOLS ARE REMOVED FROM THE NOZZLES BEFORE INSTALLING THE FUEL MANIFOLD ASSEMBLY.

CAUTION: CONNECT GROUND CABLE ON TEST RIG (REF. FIG. 202) TO ELIMINATE DANGER OF ELECTROSTATIC DISCHARGE.

CAUTION: EXERCISE EXTREME CARE WHEN HANDLING FUEL MANIFOLD NOZZLE ADAPTER ASSEMBLIES. USE CLEAN, LINT-FREE COTTON GLOVES, OR SURGICAL GLOVES, AS SKIN CONTACT WITH THE NOZZLE ORIFICE AND/OR FILMING SURFACES MAY PRODUCE A POOR SPRAY PATTERN.

NOTE: 1. Step (1), functional test for fuel manifold nozzle adapter assemblies installed in LP turbine stator assembly, does not apply to Post-SB7598 fuel manifold adapter assemblies.

NOTE: 2. If it is necessary to replenish test rig tank with fuel during the following check, release pressure by opening relief valve on hand pump, replenish tank, close relief valve and prime manifold.

(1) For JT15D-5 (Pre-SB7598) engines: Functionally test fuel manifold nozzle adapter assemblies installed in LP turbine stator assembly as follows:

(a) JT15D-5 (Pre-SB7493) engines: ensure nozzles are clean and free from carbon buildup (Ref. Para. 8.).

(b) Connect test rig (PWC31086) to main fuel inlets of fuel manifold inlet adapter using adapter from fittings (PWC31073-01) and (PWC31073-02). Fill tank of rig to specified level with clean fuel.

(c) Open primary and secondary valves on test rig and prime manifolds by operating hand pump until fuel flows from nozzle orifices. Close primary and secondary valves on test rig and replenish tank with clean, fresh fuel.

(d) JT15D-5 (Pre-SB7493) engines: install blanking caps (PWC31263) on all nozzle adapters, except nozzle to be checked.

(e) JT15D-5 (Post-SB7526 and Post-SB7493) engines: install cap-off tools (PWC52509) on all nozzle adapters, except nozzle to be checked.

(f) Supply air to test rig and pressurize tank to approximately 22 psi on 0 to 100 psi fuel gage (Ref. Figs. 202 and 203).

NOTE: Aim nozzle to be checked so fuel will spray down into a suitable clean container, in the procedures following.

(g) Open primary valve and readjust air supply to maintain 22 psi fuel pressure. Observed fuel flow must display either an open spray pattern or an onion shaped pattern free from drooling and/or spitting. Close primary valve on test rig.

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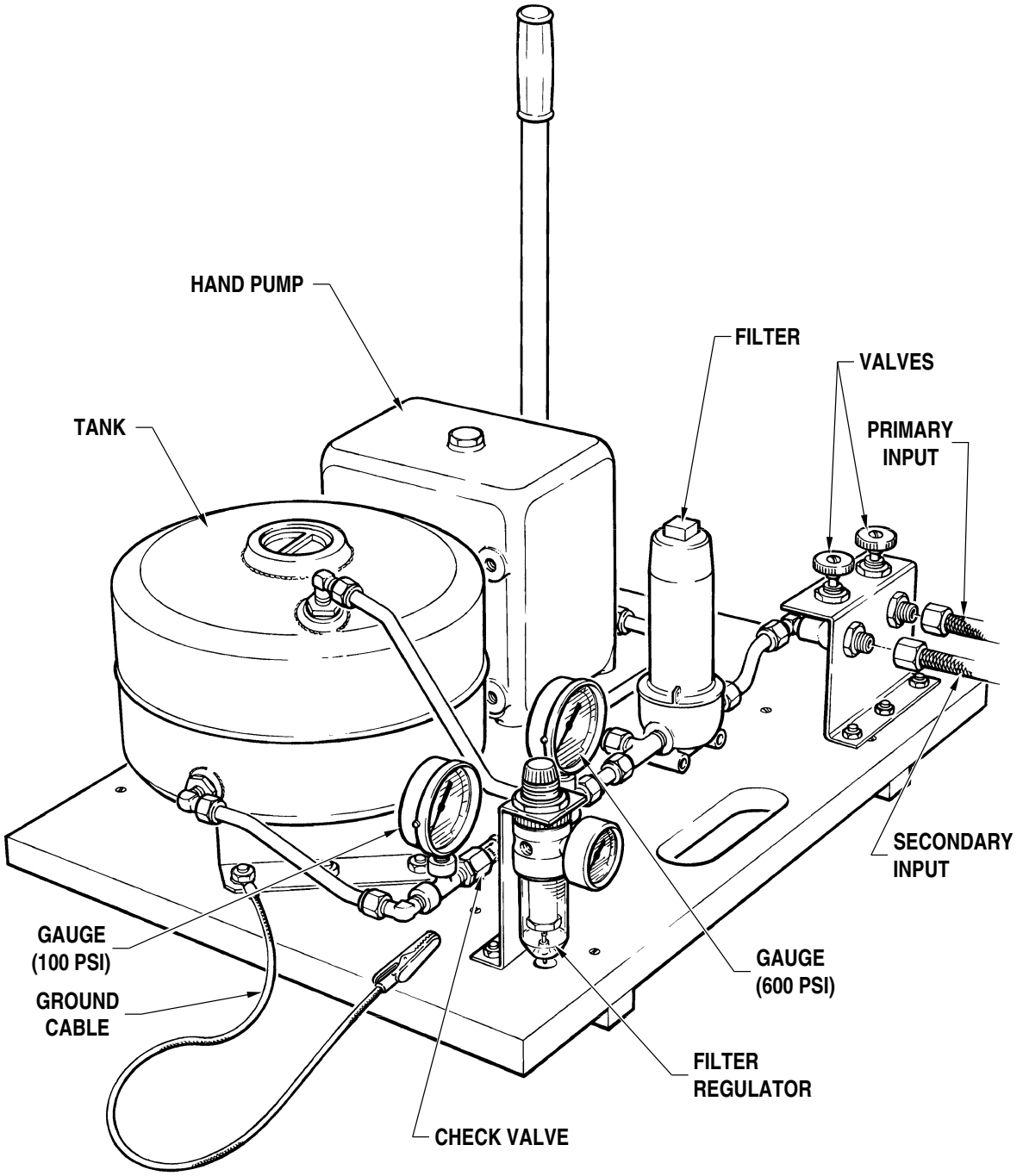

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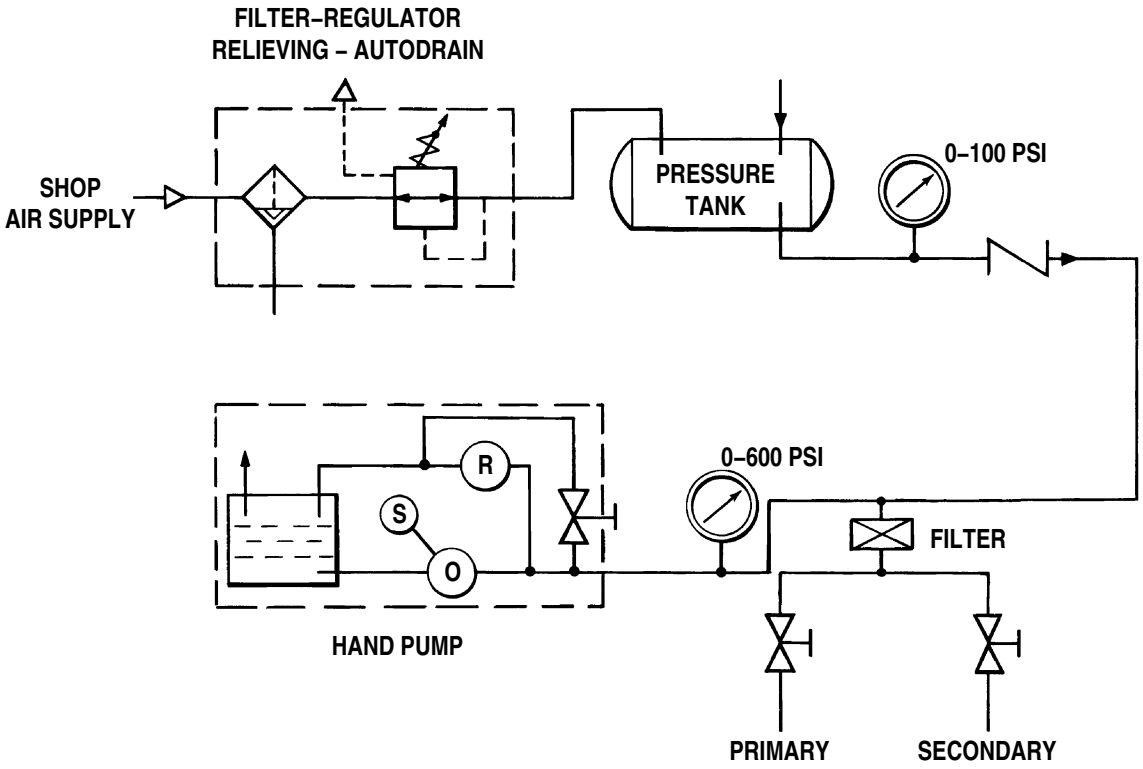
Fuel Manifold System Test Rig
Figure 202



C2158A

Fuel Manifold System Test Rig (Schematic)
Figure 203

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(h) JT15D-5 (Pre-SB7493) engines: Pressurize tank to read approximately 60 psi on fuel gage.

(i) JT15D-5 (Post-SB7526 and Post-SB7493) engines: pressurize tank to read approximately 100 psi on fuel gage.

(j) JT15D-5 (Pre-SB7493) engines: Open primary and secondary valves, and readjust air supply to maintain 60 psi fuel pressure. Observed fuel flow must be free from drooling and/or spitting. A maximum of 20 percent streakiness is permitted.

(k) JT15D-5 (Post-SB7526 and Post-SB7493) engines: Open secondary valves, and readjust air supply to maintain 100 psi fuel pressure. Observed fuel flow must be free of voids and heavy streaks.

(l) Repeat procedure for each nozzle in turn.

(m) Nozzles rejected at steps (g) and (j)or (k), preceding, should be removed and replaced as instructed in Paragraph 9., Repair.

(n) Remove all capping tools from the fuel nozzles.

(o) Disconnect test rig.

(2) Functionally test individual uninstalled fuel manifold nozzle adapter assemblies.

NOTE: 1. Step (2)(a) details atomization testing for uninstalled individual fuel manifold assemblies.

NOTE: 2. Step (3) details testing for uninstalled individual fuel manifold adapter assemblies removed for troubleshooting of cross-manifold leakage (Ref. 72-00-00, FAULT ISOLATION).

(a) Test uninstalled individual nozzle adapter assemblies not removed for troubleshooting, as follows:

1 Install new preformed packings on two fixtures (PWC31031)(Ref. Fig. 204).

2 Connect test rig (PWC31086) to fixture (PWC31031) and fill tank with clean fuel to specified level.

3 If fuel inlet nozzle adapter is to be tested, blank off main fuel inlet tubes, using fittings (PWC31073-01) and (PWC31073-02), and plug (PWC31261).

NOTE: Aim nozzle so fuel will spray down into a suitable clean container, in the procedures following.

4 Supply air to test rig and pressurize tank to approximately 22 psi on 0 to 100 psi fuel gage (Ref. Figs. 202 and 203).

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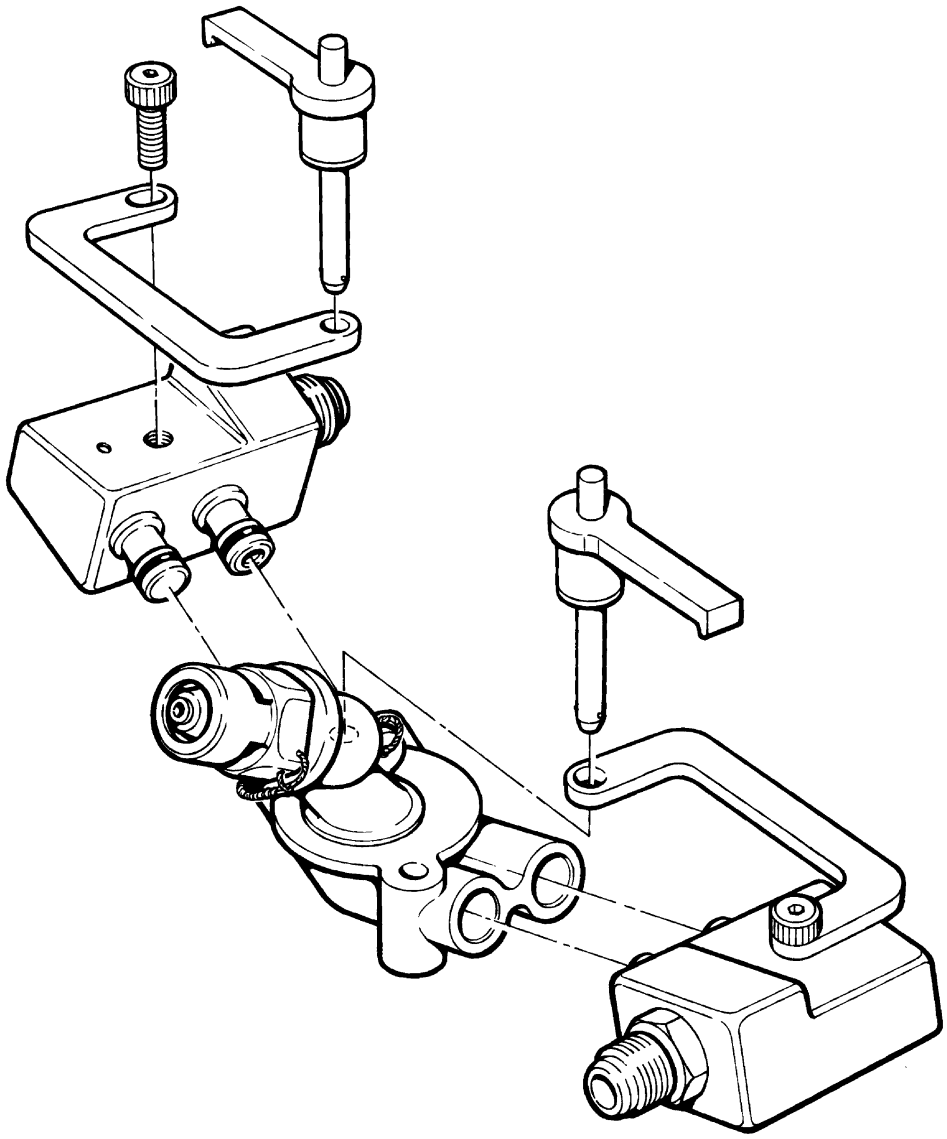

C2157A

Fuel Nozzle Adapter Assembly - Functional Check Fixtures
Figure 204

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5 Atomization check: open primary valve and readjust air supply to maintain 22 psi fuel pressure. Observed fuel flow must display either an open spray pattern or an onion shaped pattern free from drooling and/or spitting. Close primary valve on test rig.

6 Pressurize tank to read approximately 60 psi on 0 to 100 psi fuel gage.

7 JT15D-5 (Pre-SB7493) engines: Open primary and secondary valves, and readjust air supply to maintain 60 psi fuel pressure. Observed fuel flow must be free from drooling and/or spitting. A maximum of 20 percent streakiness is permitted.

8 JT15D-5 (Post-SB7526 and Post-SB7493) engines: open secondary valve and readjust air supply to maintain 100 psi fuel pressure. Observed fuel flow must be free of voids and heavy streaks.

9 Disconnect test rig.

10 Following successful functional check, install nozzle adapter(s) and transfer tubes on LP turbine stator support assembly (Ref. Para. 5.B.), then accomplish fuel manifold pressure test, following (Ref. Subpara. 6.C.).

(3) Following referral from fault isolation for hot starts or low fuel boost pressure indications (Ref. 72-00-00, FAULT ISOLATION) , check individual fuel nozzle adapter assemblies for primary-to-secondary manifold leakage as follows:

(a) Connect primary input of test rig (PWC31086) to fixture (PWC31031) to supply fuel to primary section of nozzle and fill tank with clean fuel to specified level (Ref. Figs. 202 and 203).

(b) Open primary valve and close secondary valve on test rig. Using hand pump, increase supply pressure to 170 to 200 psi with flow from primary section of nozzle only. Observe fitting of interconnect fixture (PWC31031) for leakage from secondary system over a one-minute period. Replace packings on leaking assemblies (Ref. Para. 9.) and repeat check. Record leakage observed and sum the leakage of all nozzles.

NOTE: 1. If the summed rate is within 30 cc/min. of the rate recorded during engine fault isolation run, replace only those nozzles in leaking assemblies.

NOTE: 2. If agreement between summed individual leakage and the rate at idle is not within 30 cc/min., replace all nozzles.

(c) After nozzle replacement, repeat primary-to-secondary manifold leakage check. If secondary flow is still evident, reject and replace manifold adapter on leaking nozzle/adapter assembly.

NOTE: If the inlet adapter assembly is checked, the normal fuel inlets must be blanked off using two fittings (PWC31073-01) and (PWC31073-02), and plug (PWC31261).

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CAUTION: UNDER NO CIRCUMSTANCES ARE ASSEMBLIES, INCLUDING REPLACEMENT PARTS, THAT FAIL EITHER CROSS-MANIFOLD LEAKAGE CHECK OR ATOMIZATION CHECK TO BE REINSTALLED IN ENGINE.

(d) Carry out atomization check as detailed in step (2)(a)5, preceding.

(e) Following successful functional check, install nozzle adapter(s) and transfer tubes on LP turbine stator support assembly (Ref. Para. 5.B.), then accomplish fuel manifold pressure test (Ref. Subparas. 6.C. or 6.D., as applicable).

C. JT15D-5 (Pre-SB7598) Fuel Manifold Leak Test using PWC30186 Test Rig (Ref. Fig. 202)

NOTE: Do not use this procedure for JT15D-5 (Post-SB7598) or JT15D-5R nozzle/adapter assemblies.

(1) Connect test rig (PWC31086) to main fuel inlets of manifolds and prime manifolds (Ref. Para. 6.B., step (1)(b)).

(2) JT15D-5 (Pre-SB7493) engines:Install blanking caps (PWC31263) on all nozzle adapters.

(3) JT15D-5 (Post-SB7493 and Post-SB7526) engines: Install cap-off tools (PWC52509) on all nozzle adapters. Tighten threaded portion of tool 12 to 16 lb.in.

NOTE: Check that preformed packing is installed in tool.

(4) Using hand pump and with both valves on test rig open, pressurize manifolds to 500 psi and check for leaks at manifold transfer tubes. No leaks are permitted at transfer tubes, but leakage may be evident at blanked-off orifice of nozzle adapter and is acceptable.

(5) JT15D-5 (Pre-SB7493) engines: Disconnect test rig and remove blanking caps. Tighten sheaths to recommended torque (REF. NO. 1712, Table 202) and lockwire to nozzle adapter body .

(6) JT15D-5 (Post-SB7493 and Post-SB7526) engines: disconnect test rig and remove all cap-off tools (PWC52509). Lockwire nozzle assembly to nozzle adapter body (Ref. Repair, Figure 206).

CAUTION: MAKE SURE THAT ALL THE FUEL NOZZLE CAPPING TOOLS HAVE BEEN REMOVED FROM THE NOZZLES BEFORE INSTALLING THE FUEL MANIFOLD ASSEMBLY.

(7) Install completed manifold assembly (Ref. Subpara. 5.B.).

D. Fuel Manifold Leak Test for JT15D-5 (Post-SB7598) and JT15D-5R Nozzle Adapter Assemblies

(1) Install one preformed packing AS3209-014 on inlet plug (PWC52693).

(2) Install two suitable preformed packings on manifold inlet adapter (PWC52701).

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(3) Lubricate the threads of inlet plug (PWC52693) with engine oil (PWC03-001) and install in the secondary (forward) inlet port in the fuel manifold inlet adapter, at the 6'o'clock position. Tighten and torque the plug to 110 to 120 lb.in.

(4) Lubricate larger diameter threads of the manifold inlet adapter (PWC52701) with engine oil and install in the primary (rear) inlet port in the fuel manifold inlet adapter, at the 6'o'clock position. Tighten and torque the plug to 110 to 120 lb.in.

(5) Connect a suitable supply of nitrogen (PWC05-050) to inlet adapter (PWC52701) installed in the primary fuel manifold inlet port.

NOTE: Mating thread size is .4375-20UNJF-3A.

(6) Turn on the nitrogen supply and set the pressure to 480 to 500 psig for 30 seconds to seat manifold preformed packings.

(7) Reduce nitrogen pressure to 50 to 55 psig and check for leakage at gaps between the fuel nozzles and transfer tubes (24 locations) using leak check fluid, (PWC05-007) at all 24 locations. No leaks are permitted.

NOTE: 1. Air leak from the small orifice at the center of plug (PWC52693) when nitrogen is applied to the primary manifold is acceptable.

NOTE: 2. When nitrogen is applied to the secondary fuel inlet, no leaks should appear at the 0.020 inch orifice cap.

(8) Increase nitrogen pressure to 480 to 500 psig. Check for leakage at gaps between the fuel nozzles and transfer tubes using leak check fluid (PWC05-007) at all 24 locations. No leaks are permitted.

NOTE: 1. Air leak from the small orifice at the center of plug (PWC52693) when nitrogen is applied to the primary manifold is acceptable.

NOTE: 2. When nitrogen is applied to the secondary fuel inlet, no leaks should appear at the 0.020 inch orifice cap.

(9) If a leak is identified at any of the described locations, then the fuel manifold must be disassembled for repair.

(10) Shut off nitrogen supply to the primary fuel manifold inlet adapter (PWC52701) and remove connection.

(11) Loosen and remove plug (PWC52693) and inlet adapter (PWC52701) from the secondary and primary fuel manifold inlets, respectively.

(12) Lubricate the threads of inlet plug (PWC52693) with engine oil (PWC03-001) and install in the primary (rear) inlet port in the fuel manifold inlet adapter. Tighten and torque the plug to 110 to 120 lb.in.

(13) Lubricate larger diameter threads of the manifold inlet adapter (PWC52701) with engine oil and install in the secondary (forward) inlet port in the fuel manifold inlet adapter. Tighten and torque the plug to 110 to 120 lb.in.

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(14) Connect the nitrogen supply to adapter (PWC52701) installed in the secondary fuel manifold inlet port.

(15) Repeat steps (6) to (10).

(16) Remove plug (PWC52693) and adapter (PWC52701) from the inlet ports in the fuel manifold inlet adapter.

(17) Lockwire nozzle assembly to nozzle adapter body (Ref. Repair, Figure 206).

(18) Install completed manifold assembly (Ref. Subpara. 5.B.).

7. Inspection/Check

CAUTION: EXERCISE EXTREME CARE WHEN HANDLING FUEL MANIFOLD NOZZLE ASSEMBLIES. USE CLEAN, LINT-FREE COTTON GLOVES, OR SURGICAL GLOVES, AS SKIN CONTACT WITH THE NOZZLE ORIFICE AND/OR FILMING SURFACE MAY PRODUCE A POOR SPRAY PATTERN.

A. Fuel Nozzle Assembly

(1) JT15D-5 (Pre-SB7493) engines: check nozzle assembly for burrs and similar defects. Threads and hexagon may be lightly stoned to remove nicks and burrs (Ref. Para. 9.).

(2) JT15D-5 (Pre-SB7493) engines: Inspect nozzle sheath for corrosion. Eroded areas may be lightly buffed (Ref. Para. 9.).

(3) JT15D-5 (Post-SB7493, Post-SB7526 and Post-SB7598) and JT15D-5R (hybrid-type) nozzle assemblies: inspect in accordance with P&WC Component Maintenance Manual (CMM), 73-10-21, P&WC publication P/N 3043606.

8. Cleaning/Painting

A. Fuel Nozzle Assemblies:

CAUTION: EXERCISE EXTREME CARE WHEN HANDLING FUEL NOZZLE ASSEMBLIES. USE CLEAN, LINT-FREE COTTON GLOVES, OR SURGICAL GLOVES, AS SKIN CONTACT WITH THE NOZZLE ORIFICE AND/OR FILMING SURFACE MAY PRODUCE A POOR SPRAY PATTERN.

CAUTION: DO NOT BRUSH NOZZLES WITHOUT AIR PRESSURE OR SMALL CARBON PARTICLES MIGHT ENTER AND BLOCK ORIFICES.

(1) JT15D-5 (Pre-SB7493) engines: Clean fuel nozzles that exhibit signs of carbon buildup. Clean nozzle dual orifices by brushing lightly with a soft bristled-nylon or bronze brush and simultaneously introducing a blast of clean, dry, filtered compressed air into the nozzle adapter fuel inlets.

(2) JT15D-5 (Post-SB7493, Post-SB7526 and Post-SB7598) and JT15D-5R engines: do not remove carbon buildup from, or otherwise clean fuel nozzle assemblies.

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9. Approved Repairs

A. Fuel Manifold Inlet and Automatic Fuel Shut-off Valve Assembly - Repair by Replacement (Ref. Fig. 205)

(1) Refer to Table 203, REF. NO. 1805.

(2) Dismantling of fuel manifold inlet and automatic shut-off valve assembly should be effected only to extent necessary to facilitate transfer of detail parts from unserviceable assembly to replacement assembly. Proceed as follows:

(a) Remove plug (9) and remove spring washers (8) and seat (7) from fuel manifold inlet and shut-off valve assembly.

(b) Remove bolts (1) and remove overspeed control linkage housing (2). Do not dismantle linkage housing any further.

(c) Lift out valve release plate (3).

(d) Press out piston (5) taking care not to drop fuel shut-off valves (4). Discard preformed packings.

NOTE: Piston preformed packings are replaced to rectify cross-manifold leakage. Remove piston from housing by inserting No. 190-32 UNF-28 threaded rod into threaded extraction feature on piston.

(e) Remove protective caps from replacement assembly.

CAUTION: ENSURE SHUT-OFF VALVES (4) ARE INSTALLED BEFORE INSTALLING PISTON.

(f) Install new preformed packings and shut-off valves (4) in piston (5) and press piston into housing assembly (6).

(g) Position valve release plate (3) in control linkage housing (2) and install on housing assembly (6). Secure with two bolts (1) making sure that the upper bolt is passed through the bracket which supports two T6 harness loop clamps. Torque bolts to 24 to 36 lb.in. and lockwire.

CAUTION: ENSURE SPRING SEAT IS INSTALLED WITH LARGE DIAMETER FACING INTO SHUT-OFF VALVE HOUSING.

(h) Install seat (7) and ten spring washers (8) on piston (5).

(i) Install new preformed packing on plug (9), install on housing assembly (6), tighten, torque to 65 to 75 lb.in., and secure with lockwire.

(j) Carry out tests detailed in Paragraph 6., preceding.

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B. Fuel Manifold Adapter Assemblies (Ref. Fig. 206)

NOTE: 1. Repair to fuel nozzle assemblies and to manifold adapter assemblies is confined to repair by replacement, or limited repair to specified external surfaces.

NOTE: 2. Fuel nozzles may be removed from adapter assemblies whenever the functional check performed as detailed in Para. 6. indicates that streakiness is excessive, or when troubleshooting (Ref. 72-00-00, FAULT ISOLATION) indicate that new packings are required on nozzle assemblies.

(1) Repair fuel nozzle or manifold adapter assemblies by replacement as follows:

NOTE: It is recommended during following procedures that fuel manifold system is not disassembled.

CAUTION: TAKE EXTREME CARE DURING NOZZLE REMOVAL/REPLACEMENT TO ENSURE THAT DIRT AND/OR OTHER FOREIGN MATTER DOES NOT CONTAMINATE FUEL MANIFOLD SYSTEM AND NOZZLES. WEAR CLEAN, LINT-FREE GLOVES WHEN HANDLING NOZZLES.

(a) Remove nozzle assemblies as follows:

1 JT15D-5 (Pre-SB7493) engines: Cut lockwire securing sheath (1) and nozzle assembly (2) to adapter (4). Loosen and remove sheath.

2 JT15D-5 (Pre-SB7493) engines: If required, loosen and remove nozzle assembly (2) from adapter (4). Remove and discard preformed packing using a wooden pick.

3 JT15D-5 (Post-SB7493, Post-SB7526 and Post-SB7598) and JT15D-5R engines: using nozzle wrench (PWC52294), loosen and remove nozzle assembly (2) from adapter (4). Remove and discard preformed packing using a wooden pick.

4 Repair JT15D-5 (Post-SB7493, Post-SB7526 and Post-SB7598) and JT15D-5R (hybrid-type) nozzle assemblies by replacement or in accordance with P&WC Component Maintenance Manual (CMM), 73-10-21, P&WC publication P/N 3043606.

(b) Lubricate new preformed packing with engine oil (Ref. PWC03-001) and install new packing on existing or replacement nozzle assembly.

CAUTION: ENSURE THAT NO ANTI-SEIZE COMPOUND CONTACTS ADAPTER INTERNAL THREADS OR FUEL NOZZLE THREADS.

(c) Lightly lubricate adapter to nozzle interface with antiseize compound comprising 80 percent by weight of antiseize compound (PWC06-004A) and twenty percent by weight of engine oil (PWC03-001D), mixed to a smooth consistency.

(d) JT15D-5 (Pre-SB7493) engines: install fuel nozzle assembly (2) in adapter (4). Tighten and torque (REF. NO. 1711, Table 202).

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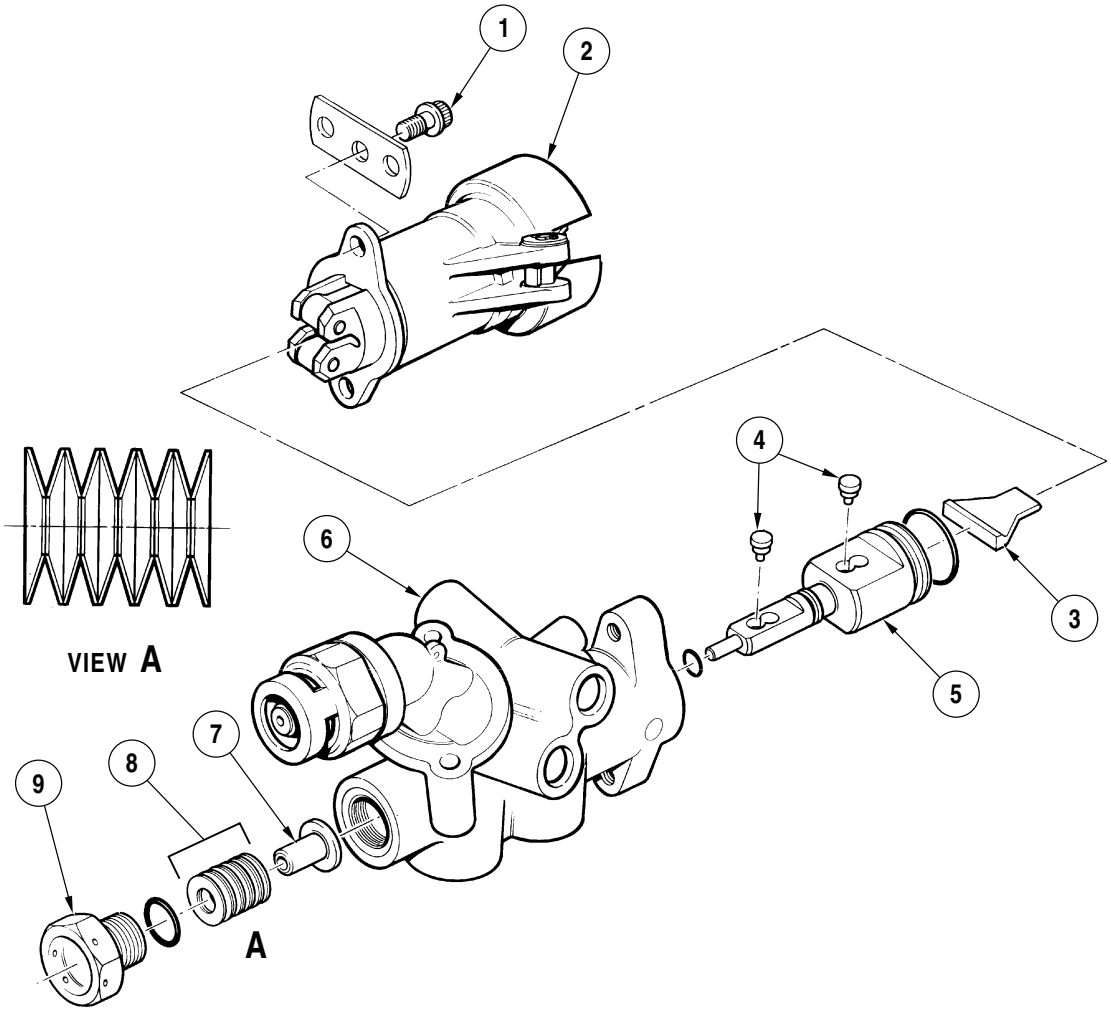

C18932

Approved Repairs - Fuel Inlet and Shut-off Valve Assembly (Typical)
Figure 205

P&WC Proprietary Information. Subject to the restriction on the title page.
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Key to Figure 205

1. Bolt
2. Control Linkage Housing
3. Release Plate
4. Shut-off Valves
5. Piston
6. Housing Assembly
7. Seat
8. Spring Washers
9. Plug

(e) JT15D-5 (Post-SB7493, Post-SB7526 and Post-SB7598) and JT15D-5R engines: install fuel nozzle assembly (2) in adapter (4). Using wrench (PWC52294), tighten and torque (REF. NO. 1711, Table 202).

NOTE: The nozzle assembly is lockwired to the nozzle adapter after the manifold leak check (Ref. Subpara. 6.C.).

(f) JT15D-5 (Pre-SB7493) engines: Install fuel nozzle assembly sheath (1). Tighten and torque sheath (REF. NO. 1712, Table 202).

(g) Perform functional and pressure checks as detailed in Paragraph 6., preceding.

(h) JT15D-5 (Pre-SB7493) engines: Remove fuel nozzle sheath (1). Reinstall sheath and torque (REF. NO. 1712, Table 202) while securing nozzle assembly (2) and sheath to adapter (4) with lockwire.

(2) Repair surface damage to fuel nozzle adapter assembly components as follows (JT15D-5 Pre-SB7493 engines):

CAUTION: REPAIRS ARE NOT PERMITTED ON NOZZLE ASSEMBLY ORIFICE FACE.

(a) Fuel nozzle assembly: repair is allowable to JT15D-5 (Pre-SB7493) fuel nozzle assemblies and fuel nozzle sheaths and is limited to local blending of minor defects such as scores, nicks, scratches and gouges on exterior surfaces. Clean up minor defects by blending with a fine stone or by polishing with crocus cloth, ensuring that all sharp edges and high spots are removed. Thread damage on nozzles may be cleaned up using a suitable swiss file, or by chasing threads with appropriate size tap or die.

(b) Manifold adapter and inlet manifold adapter assemblies: repair to nozzle adapter assemblies is limited to local blending of minor defects such as scores, nicks, scratches and gouges on exterior surfaces. Clean up minor defects by blending with a fine stone or by polishing with crocus cloth, ensuring that all sharp edges and high spots are removed. Thread damage on adapters may be cleaned up using a suitable swiss file, or by chasing threads with appropriate size tap or die.

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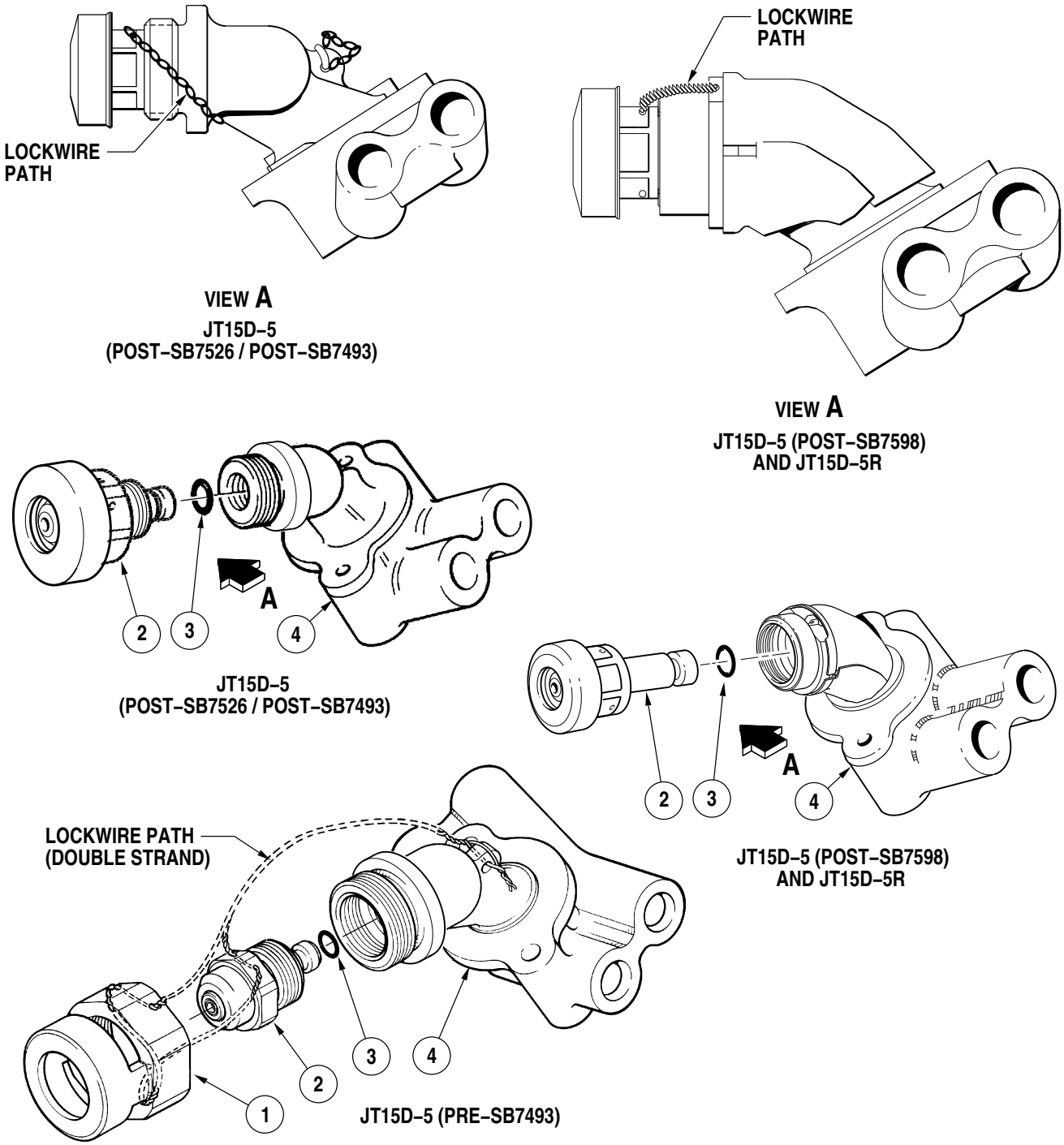

C17458D

Approved Repairs - Fuel Manifold Adapter Assemblies
Figure 206

Key to Figure 206

1. Fuel Nozzle Sheath, JT15D-5 (Pre-SB7493 and Pre-SB7526)
2. Nozzle Assembly
3. Preformed Packing
4. Adapter

(c) Clean all parts after repair by pressure washing in petroleum solvent (PWC11-027).

10. Fits, Clearances and Torque Loadings

A. Refer to Tables 202, 203 and Figure 207.

TABLE 201, Fits and Clearances

REF. NO.	Name	Dim. for Ref. (inches) Min.	Dim. for Ref. (inches) Max.	Limits (inches) Min.	Limits (inches) Max.	Limits (inches) Replace
Not Applicable						

TABLE 202, Torque and Stretch

REF. NO.	Name	Limits Min.	Limits Max.
1711	Nozzle Assembly, Fuel	150	160
1712	JT15D-5 (Pre-SB7493) engines: Sheath, Fuel Nozzle	350	375

TABLE 203, Spring Pressure

REF. NO.	Name	Limits Min.	Limits Max.
1805	Fuel Shut-off Valve Piston Spring		
	Tension Washer (Stacked) at 0.070 deflection	86 lb 6 oz	105 lb 10 oz
	Tension Washer (Stacked) at 0.120 deflection	132 lb 5 oz	161 lb 11 oz

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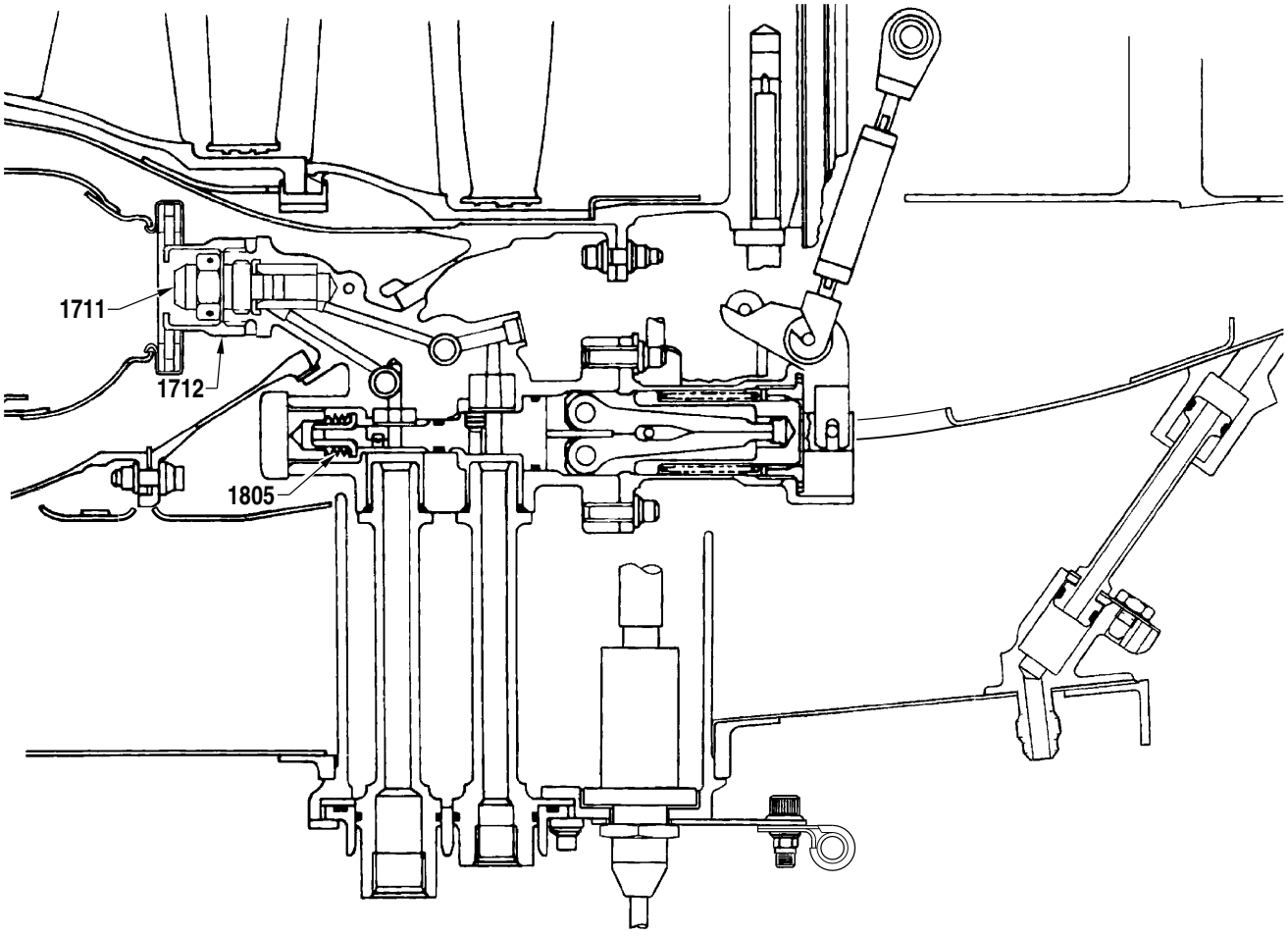
TABLE 204, Special Assembly

REF. NO.	Name	Limits Min.	Limits Max.
Not Applicable			



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Fits, Clearances and Torque Loadings
Figure 207

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FUEL DRAIN VALVE - DESCRIPTION AND OPERATION

1. Fuel Drain Valve

   A drain hole in the low pressure turbine stator support assembly and two outlet bosses on the gas generator case connect to a drain valve via two drain tubes, located on the bypass duct to ensure drainage of residual fuel after engine shutdown. The drain valve is closed during engine operation by the action of P3 pressure against the spring loaded valve.

   A second drain consisting of a fuel drain tube, one end located in a boss at 6 o'clock in the rear inner bypass duct and the other in a drain boss outlet of the outer bypass duct, ensures drainage of residual fuel from the exhaust area in the event of a wet motoring cycle or an aborted start.

FUEL DRAIN VALVE - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the gas generator case fuel drain valve.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC05-019	Lapping Compound
PWC11-027	Petroleum Solvent

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal of Gas Generator Case Fuel Drain Valve (Ref. Fig. 201)

      (1) For JT15D-5 Pre-SB7591 engines: Remove lockwire from coupling nuts on two P3 air delivery tubes. Disconnect tubes from nipples (8).

      (2) For JT15D-5 Post-SB7591 and JT15D-5R engines: Remove the lockwire from coupling nut on the P3 air delivery tube. Disconnect the tube from the nipple (8).

      (3) For JT15D-5 Post-SB7591 and JT15D-5R engines: Remove the lockwire from tube cap (9). Remove the cap from the nipple (8).

      (4) Remove two nipples (8) with preformed packings (7). Discard packings.

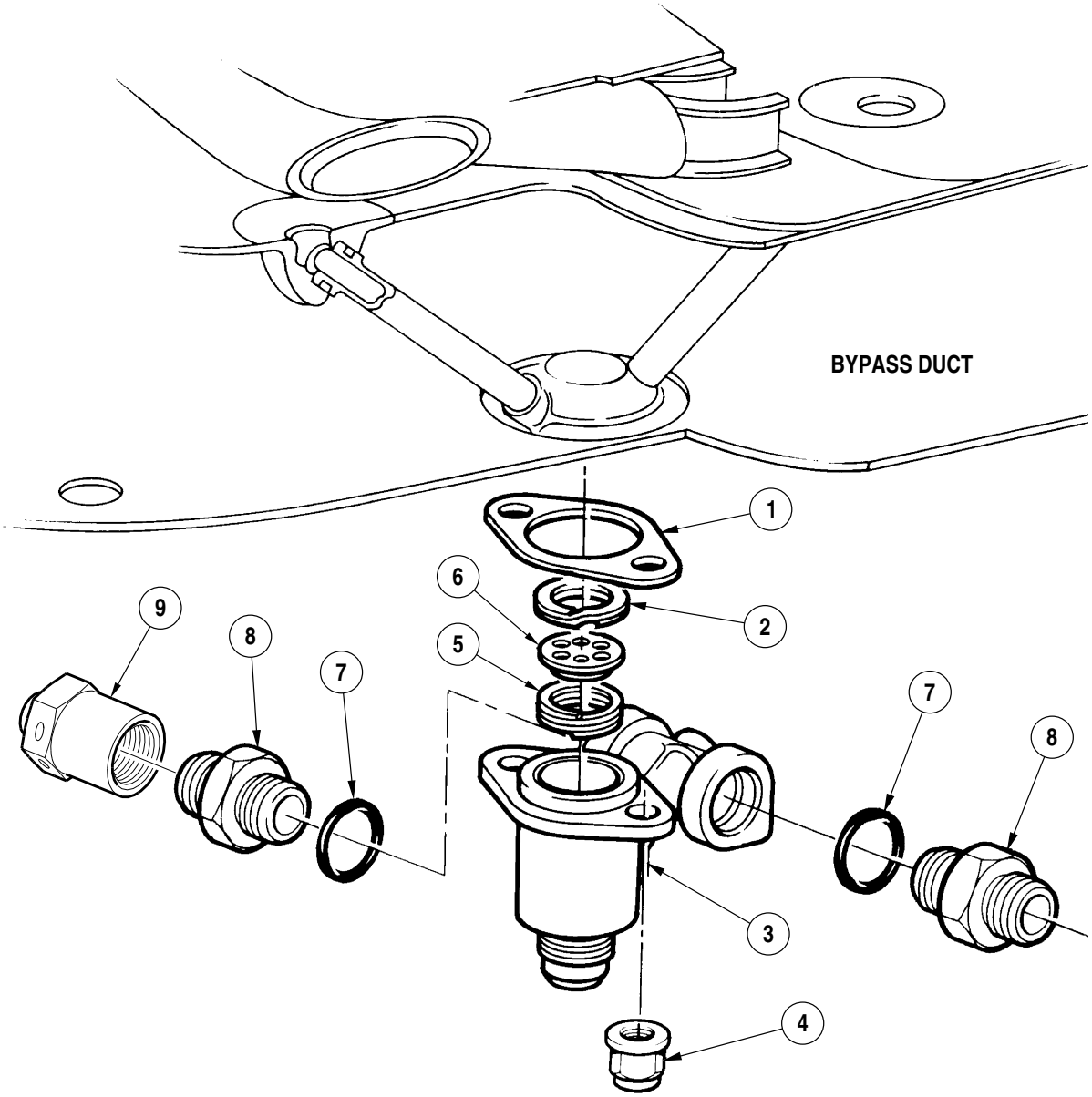
      (5) Remove two self-locking nuts (4) securing drain valve assembly to bypass duct. Remove drain valve assembly and gasket (1) . Discard gasket.

      (6) Remove retaining ring (2) and remove drain valve (6) and spring (5) from housing (3).

   B. Installation of Gas Generator Case Fuel Drain Valve (Ref. Fig. 201)

      (1) Lightly lap drain valve (6) in drain valve housing (3) using lapping compound (PWC05-019).

      (2) Remove all traces of lapping compound by washing drain valve and housing in petroleum solvent (PWC11-027).



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Gas Generator Case Fuel Drain Valve
Figure 201

Key to Figure 201

1. Gasket
2. Retaining Ring
3. Housing
4. Self-locking Nut (Two)
5. Spring
6. Drain Valve
7. Preformed Packing
8. Straight Nipple
9. Tube Cap, JT15D-5 (Post-SB7591) and JT15D-5R

(3) Assemble drain valve (6) and valve spring (5) in housing (3) and secure with retaining ring (2).

(4) Position new gasket (1) and drain valve assembly on bypass duct mounting studs. Secure with two self-locking nuts (4). Tighten and torque nuts to 32 to 36 lb.in.

(5) Install new preformed packing (7) on each nipple (8) and install nipples into bosses on drain valve housing assembly (3). Tighten and torque nipples 65 to 75 lb.in.

(6) For JT15D-5 Pre-SB7591 engines: Connect the coupling nuts of the two P3 air delivery tubes to the nipples (8). Torque the coupling nuts 90 to 100 lb.in. Lockwire the coupling nuts.

(7) For JT15D-5 Post-SB7591 and JT15D-5R engines: Connect the coupling nut of the P3 air delivery tube to the nipple (8). Torque the coupling nut 90 to 100 lb.in. Lockwire the coupling nuts.

(8) For JT15D-5 Post-SB7591 and JT15D-5R engines: Connect the tube cap (9) to the nipple (8). Torque the tube cap 65 to 75 lb.in. Lockwire the tube cap.

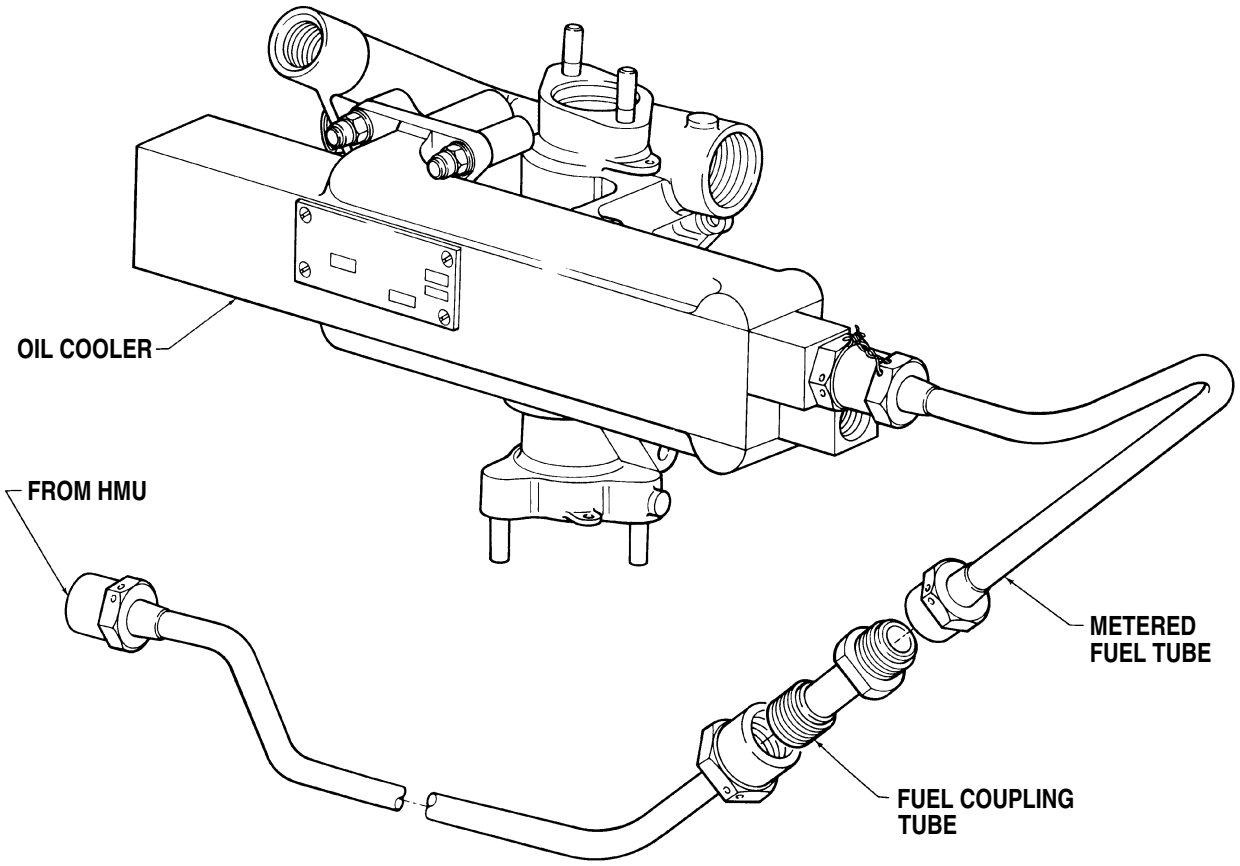
C. Exhaust Area Fuel Drain

Refer to Chapter 72-70-02 for removal and installation procedures for exhaust area fuel drain tube.

FUEL FLOWMETER INSTALLATION - DESCRIPTION AND OPERATION

1. Fuel Flowmeter (Ref. 1)

   Provision is made for installing an airframe-supplied fuel flowmeter in the metered fuel tube between the HMU and the oil cooler. A fuel coupling tube is removed from the metered fuel tube to allow installation of a flowmeter, or is left installed if the flowmeter is not required (Ref. 73-10-01).



C11546

Provision for Fuel Flowmeter Installation (Typical)
Figure 1

FUEL FLOWMETER INSTALLATION - MAINTENANCE PRACTICES

1. Removal/Installation

   Refer to Chapter 73-10-01 and to the Airframe Maintenance Manual to remove and install the fuel flowmeter.

FUEL PRESSURE AND BYPASS TUBES - DESCRIPTION AND OPERATION

1. External Pressure and Bypass Fuel Tubes

   The external primary and secondary fuel pressure tubes direct fuel from the flow divider valve through the manifold inlet adapter fuel pressure tubes (Ref. 73-10-03) located in the bypass duct. The fuel bypass tube locates between the flow divider valve and the HMU and returns excess fuel flow back to the fuel pump inlet.

FUEL PRESSURE AND BYPASS TUBES - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the fuel pressure and bypass tubes.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC11-027	Petroleum Solvent

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal of Primary and Secondary Pressure Fuel Tubes and Bypass Tube (Ref. Fig. 201)

      (1) Remove self-locking nut (9), bolt (7), and spacer (8) securing loop clamps (5) and (6). Remove loop clamps.

      (2) Remove loop clamps, disconnect coupling nuts at both ends of primary (2) and secondary (3) fuel pressure tubes and remove tubes.

      (3) Disconnect coupling nuts at both ends of fuel bypass tube (1) and remove tube.

   B. Installation of Primary and Secondary Pressure Fuel Tubes and Bypass Tube (Ref. Fig. 201)

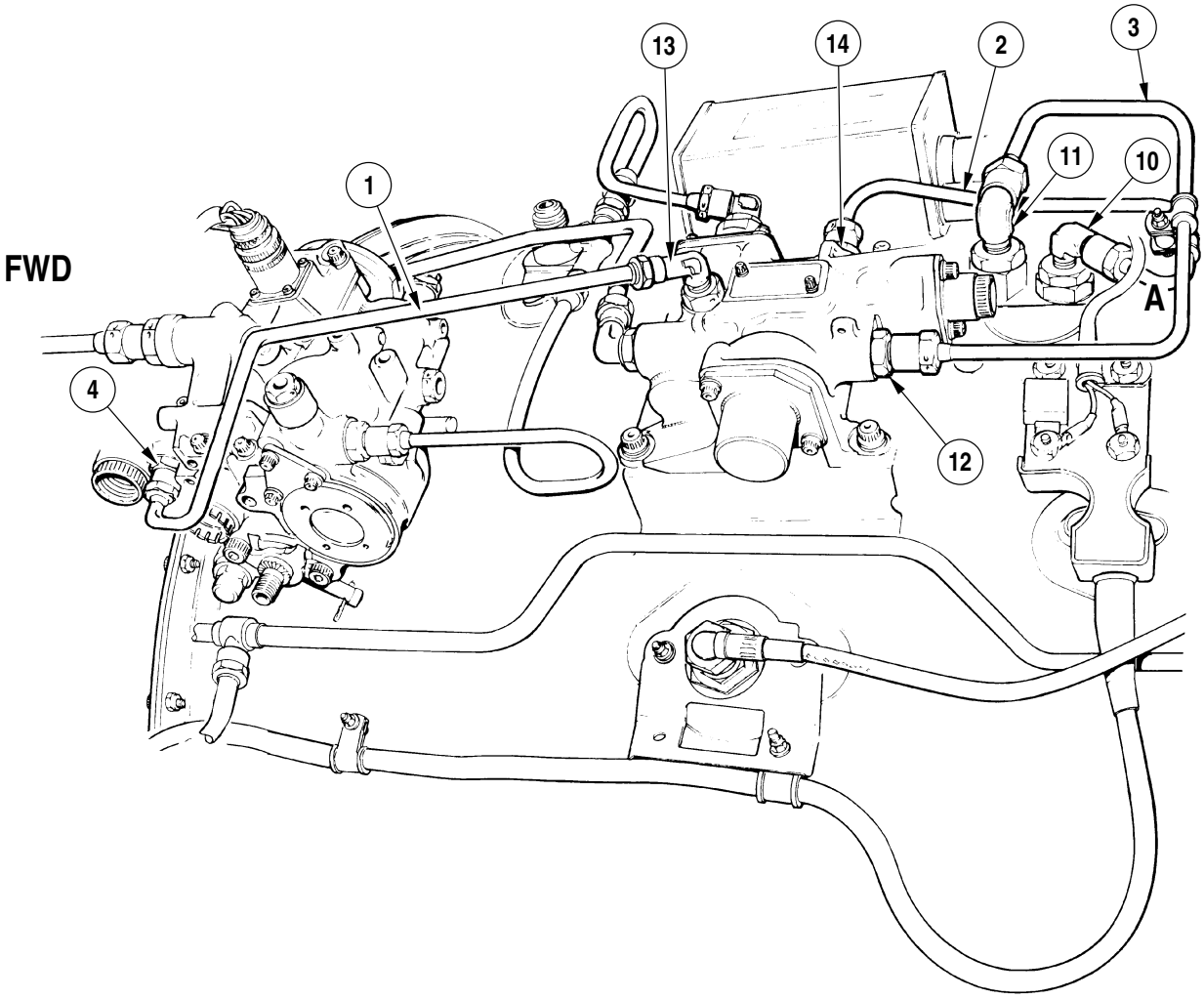
      (1) Install loop clamp (6) on primary fuel pressure tube (2), install tube and mate coupling nuts to straight nipple (14) and small elbow (10). Tighten and torque to 90 to 100 lb.in.

      (2) Install loop clamp (5) on secondary fuel pressure tube (3), install tube and mate coupling nuts to straight nipple (12) and large elbow (11). Tighten and torque coupling nuts to 270 to 300 lb.in.

      (3) Position spacer (8) between loop clamp assemblies and secure with bolt (7) and nut (9) (Ref. Detail A).

      (4) Install fuel bypass tube assembly (1) between elbow (13) and straight nipple (4). Tighten and torque coupling nuts to 90 to 100 lb.in.

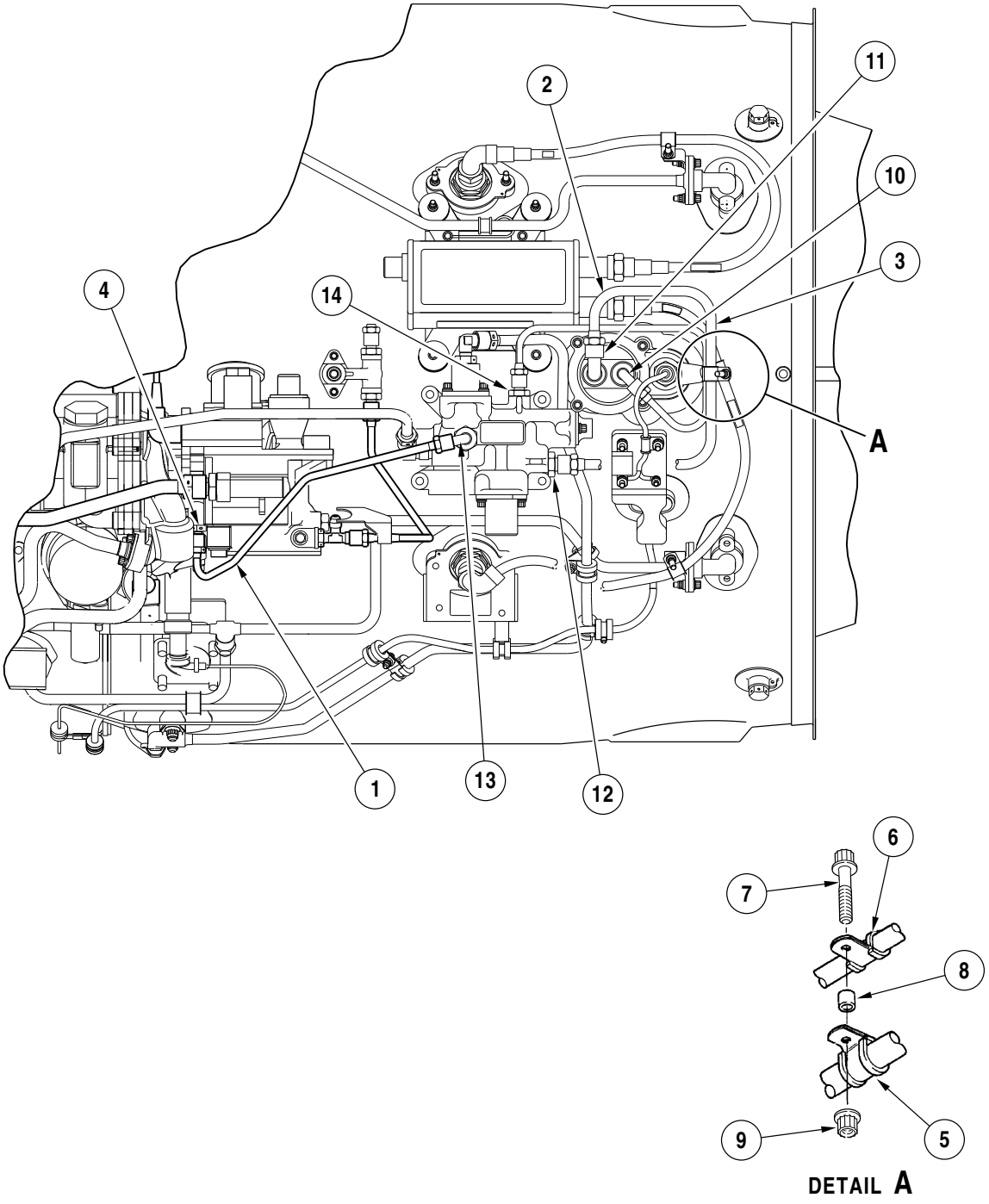
      (5) Lockwire all connections.



JT15D-5 Only

C11508

Removal/Installation - Primary and Secondary Fuel Pressure and Fuel Bypass Tubes
Figure 201 (Sheet 1 of 2)



JT15D-5R Only

C108851

Removal/Installation - Primary and Secondary Fuel Pressure and Fuel Bypass Tubes
Figure 201 (Sheet 2)

Key to Figure 201

1. Fuel Bypass Tube
2. Primary Fuel Pressure Tube
3. Secondary Fuel Pressure Tube
4. Straight Nipple
5. Loop Clamp
6. Loop Clamp
7. Bolt
8. Spacer
9. Self-locking Nut
10. Elbow
11. Elbow
12. Straight Nipple
13. Elbow
14. Straight Nipple

6. Inspection/Check

A. Fuel Tubes

(1) Scratches - Minor scratches having no appreciable depth are acceptable. Scratches to a depth of 0.005 inch must be blended out. Replace tubing with scratches over 0.005 inch deep.

(2) Nicks - Individual nicks up to 0.062 inch long by 0.010 inch wide and 0.003 inch deep can be ignored. Nicks to a maximum depth of 0.005 inch must be blended out to remove sharp edges. Replace tubing with nicks greater than 0.005 inch deep.

(3) Dents - Round bottomed dents on straight sections of tubing are permitted provided the length and depth are not greater than 10 percent of the normal outside diameter of tube. No more than one dent to maximum depth per 12 inch length of tube is acceptable. Dents on tube bends, which cause restriction by flattening and local weakening, are not acceptable.

(4) Pitting - Minor isolated pitting up to 0.003 inch deep is acceptable. Clusters of pitting should be blended out to a maximum depth of 0.005 inch. Tubing must be replaced if pitting exceeds 0.005 inch deep.

(5) Corrosion - Staining on tubing and surface corrosion is acceptable if removable by light polishing with crocus cloth and oil.

7. Cleaning/Painting

A. Pressure Fuel Tubes

(1) Clean exterior of tubing by spraying with petroleum solvent (PWC11-027), using a soft bristle brush, as necessary. Dry using compressed air, observing all normal ventilation and fire safety precautions.

(2) Clean tubing interior by pressure flushing with petroleum solvent. Dry using clean, filtered compressed air, taking particular care that no foreign matter remains in tubing.

(3) Cap tube ends immediately after cleaning, and until tube is to be installed on engine, to prevent entry of foreign matter.

HP COMPRESSOR AIR DELIVERY TUBES - DESCRIPTION AND OPERATION

1. Compressor Discharge Air Tube

   HP compressor discharge air (P3) from the compressor in the gas generator case is delivered by a short transfer tube to a straight adapter on the outer bypass duct. An external tube connects from the straight adapter to an elbow on the flow divider valve and a second tube which leads to the hydromechanical metering unit (HMU). P3 air is thus directed through the tubes to the metering section of the HMU and to the FDV for spill valve operation.

   A smaller diameter external tube connects to the T1 inlet thermocouple housing in the LP compressor case to provide anti-icing protection for the T1 thermocouple probe (Ref. 75-00-00).

HP COMPRESSOR AIR DELIVERY TUBES - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the P3 air delivery tubes.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC11-027	Petroleum Solvent

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal of the JT15D-5 Pneumatic (P3) Tubes (Ref. Fig. 201)

      (1) Disconnect coupling (4) of P3 delivery tube (2) at elbow (5) on flow divider valve.

      (2) Disconnect coupling (3) from straight nipple (6) at boss on outer bypass duct and remove tube (2).

      (3) Disconnect coupling (9) on P3 delivery tube (8) from straight nipple (10) on HMU (11).

      (4) Disconnect coupling (7) from straight nipple (6) at boss on outer bypass duct and remove tube (8).

   B. Removal of the JT15D-5R Pneumatic (P3) Tubes (Ref. Fig. 202)

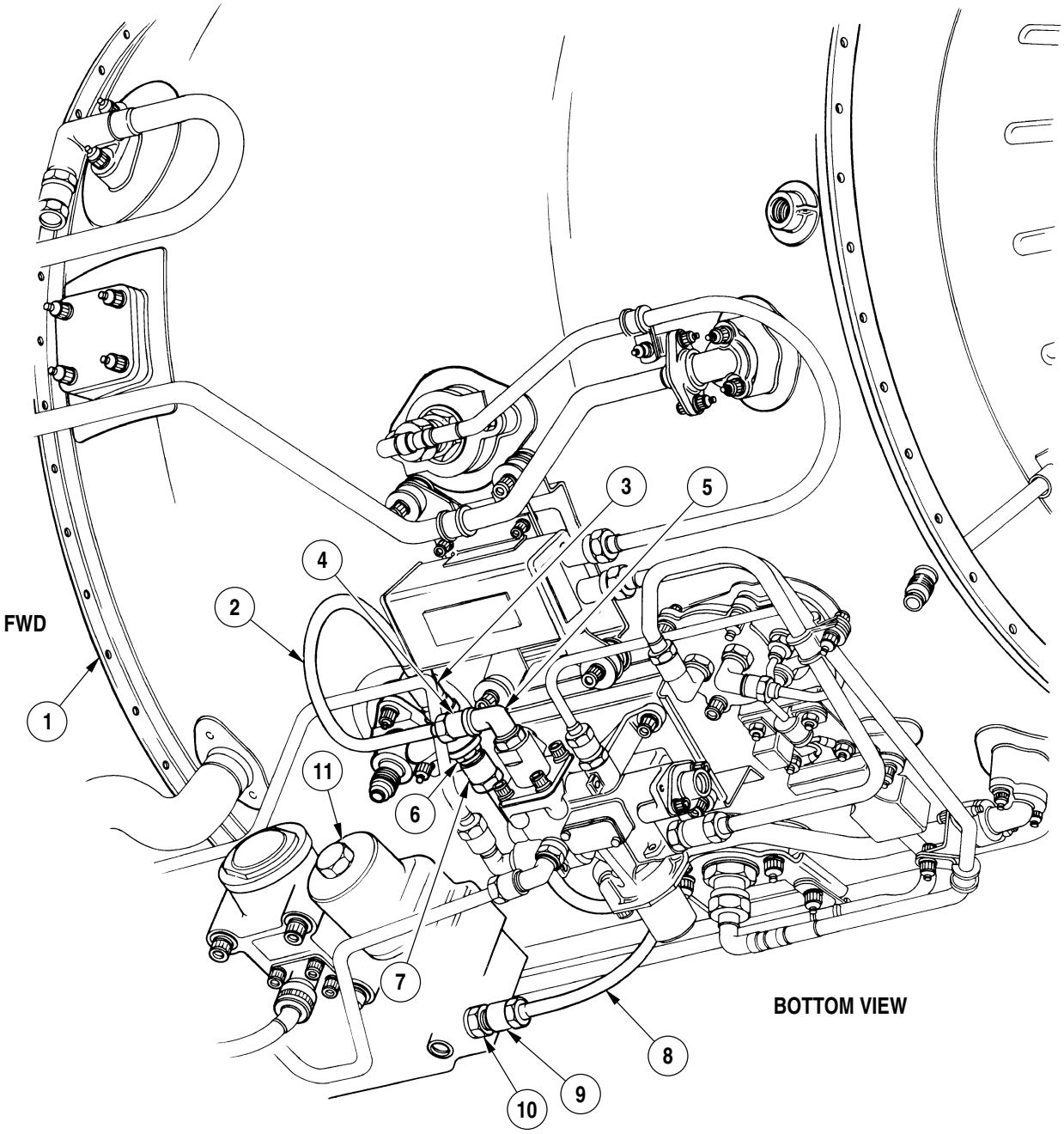
      (1) Remove the nut (13) and bolt (15) that attach the clamp (14) to the clamp (11).

      (2) Remove the nut (17), bolt (21) and spacer (16) that attach the clamp (20) to the clamp (18).

      (3) Remove the nut (30) and bolt (28) that attach the clamp (29) to the clamp (32).

      (4) Remove the nut (37) and bolt (35) that attach the clamps (33) and (36) to the bracket (34).

      (5) Disconnect the coupling (3) of P3 delivery tube (2) at elbow (4) on flow divider valve.



Removal/Installation - JT15D-5 Compressor Discharge (P3) Pneumatic Tubes
Figure 201

Key to Figure 201

1. Outer Bypass Duct
2. P3 Delivery Tube (FDV)
3. Tube Coupling
4. Tube Coupling
4. Elbow
5. Straight Adapter
6. Tee Fitting
7. Tube Coupling
8. P3 Delivery Tube (HMU)
9. Tube Coupling
10. Straight Adapter
11. Hydromechanical Metering Unit (HMU)

(6) Disconnect the T1 anti-icing tube (22) from the straight nipple (23) on the boss of the P3 delivery tube (2).

(7) Remove the nuts (27) from the studs (26) on the bypass duct.

(8) Remove the P3 delivery tube (2) from the bypass duct. Remove and discard the gasket (25) from the P3 delivery tube (2).

(9) If the P3 delivery tube (2) is replaced, remove the straight nipple (23) from the tube (2). Remove and discard the preformed packing (24) from the nipple.

(10) Disconnect the coupling (9) on the P3 delivery tube (8) from the tee fitting (10) on the HMU (11).

(11) Disconnect the coupling (7) from the tee fitting (6) and remove the tube (8).

C. Installation of the JT15D-5 Pneumatic (P3) Tubes (Ref. Fig. 201)

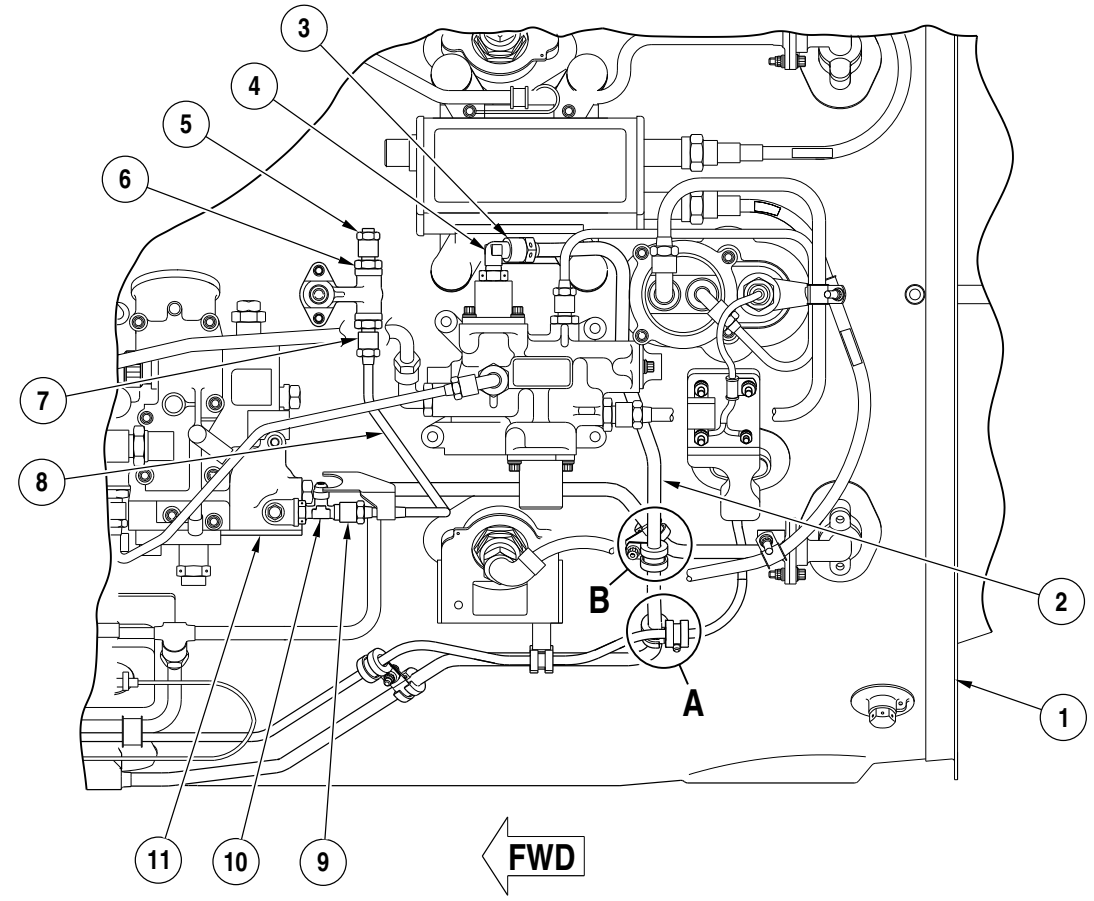
(1) Install and connect P3 delivery tube (8) to straight nipple (10) on HMU (11). Tighten both P3 tube couplings (7) and (9) to 90 to 100 lb.in.

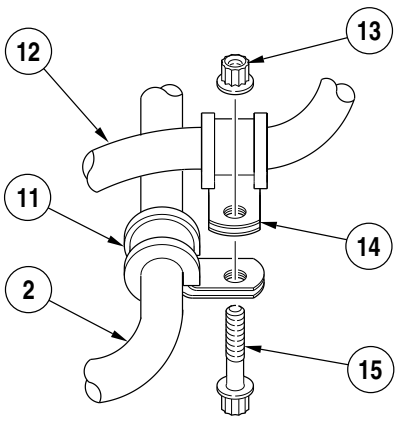
(2) Install and connect P3 delivery tube (2) to straight nipple (6) at boss on outer bypass duct and elbow (5) on FDV. Tighten P3 tube (2) couplings (3) and (4) to 90 to 100 lb.in.

D. Installation of the JT15D-5R Pneumatic (P3) Tubes (Ref. Fig. 202)

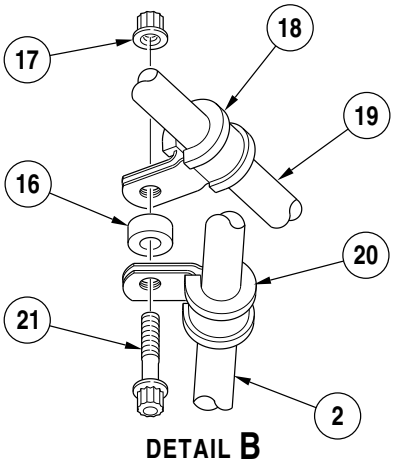
(1) For a new P3 delivery tube (2), install a new preformed packing (24) on the straight nipple (23). Install the straight nipple (23) in the P3 delivery tube (2). Torque nipple 40 to 50 lb.in.

(2) Install a new gasket (25) and the P3 delivery tube (2) on the studs (26) with the nuts (27). Torque the nuts 32-36 lb.in.





DETAIL A



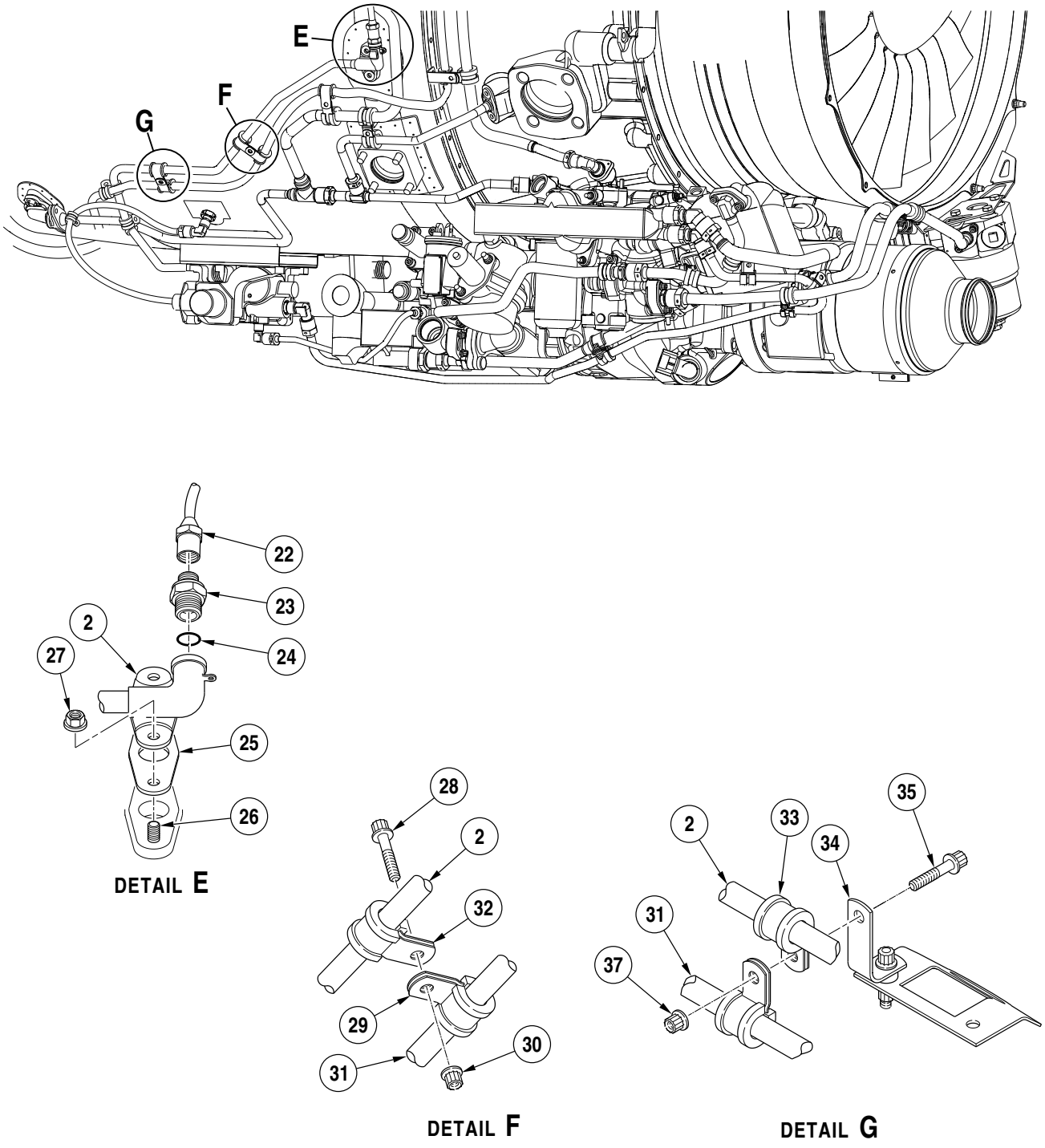
DETAIL B

C108889

Removal/Installation - JT15D-5R Compressor Discharge (P3) Pneumatic Tubes
Figure 202 (Sheet 1 of 2)

Key to Figure 202

1. Outer Bypass Duct
2. P3 Delivery Tube (FDV)
3. Tube Coupling
4. Elbow
5. End Cap (Ref.)
6. Tee Fitting
7. Tube Coupling
8. P3 Delivery Tube (HMU)
9. Tube Coupling
10. Tee Fitting
11. Bolt
12. T1 Harness
13. Nut
14. Clamp
15. Bolt
16. Spacer
17. Nut
18. Clamp
19. No. 4 Bearing Oil Pressure Tube
20. Clamp
21. Bolt
22. T1 Anti-Icing Tube
23. Nipple
24. Preformed Packing
25. Gasket
26. Stud
27. Nut
28. Bolt
29. Clamp
30. Nut
31. T1 Wiring Harness
32. Clamp
33. Clamp
34. Bracket
35. Bolt
36. Clamp
37. Nut



C108890

Removal/Installation - JT15D-5R Compressor Discharge (P3) Pneumatic Tubes
Figure 202 (Sheet 2)

(3) Connect the other end of the P3 delivery tube (2) to the elbow (4) on FDV. Torque the P3 tube coupling (3) 90 to 100 lb.in. Lockwire the coupling nut to the elbow and the FDV.

(4) Attach the clamp (14) on the T1 harness (12) to the clamp (11) on the P3 delivery tube (2) with the bolt (15) and the nut (13). Torque the nut (13) 36 to 40 lb.in.

(5) Attach the clamp (18) on the oil pressure tube (19) to the clamp (20) on the P3 delivery tube (2) with the bolt (21), spacer (16) and the nut (17). Torque the nut (17) 36 to 40 lb.in.

(6) Attach the clamp (29) on the T1 wiring harness (31) to the clamp (32) on the P3 delivery tube (2) with the bolt (28) and the nut (30). Torque the nut (30) 36 to 40 lb.in.

(7) Attach the clamp (36) on the T1 wiring harness (31) to the clamp (33) on the P3 delivery tube (2) to the bracket (34) with the bolt (35) and the nut (37). Torque the nut (37) 36 to 40 lb.in.

(8) Connect P3 delivery tube (8) to the tee fitting (10) on the HMU (11). Connect the other end of the P3 delivery tube (8) to the tee fitting (6). Tighten the P3 tube (8) couplings (7) and (9) to 90 to 100 lb.in.

NOTE: Make sure the condensation trap of the tee fitting (10) is aligned in the center of the bracket on the P3 tube (8).

(9) Lockwire all connections

6. Inspection/Check

A. Pneumatic Tubes

(1) Scratches - Minor scratches having no appreciable depth are acceptable. Scratches to a depth of 0.005 inch must be blended out. Replace tubing with scratches over 0.005 inch deep.

(2) Nicks - Individual nicks up to 0.062 inch long by 0.010 inch wide and 0.003 inch deep can be ignored. Nicks to a maximum depth of 0.005 inch must be blended out to remove sharp edges. Replace tubing with nicks greater than 0.005 inch deep.

(3) Dents - Round bottomed dents on straight sections of tubing are permitted provided the length and depth are not greater than 10 percent of the normal outside diameter of tube. No more than one dent to maximum depth per 12 inch length of tube is acceptable. Dents on tube bends, which cause restriction by flattening and local weakening, are not acceptable.

(4) Pitting - Minor isolated pitting up to 0.003 inch deep is acceptable. Clusters of pitting should be blended out to a maximum depth of 0.005 inch. Tubing must be replaced if pitting exceeds 0.005 inch deep.

(5) Corrosion - Staining on tubing and surface corrosion is acceptable if removable by light polishing with crocus cloth and oil.

7. Cleaning/Painting

A. Pneumatic Tubes

(1) Clean exterior of tube by spraying with petroleum solvent (PWC11-027) using a soft bristle brush, as necessary. Dry using compressed air, observing all normal ventilation and fire safety precautions.

(2) Clean tube interior by pressure flushing with petroleum solvent. Dry using clean, filtered compressed air, taking particular care that no foreign matter remains in tube.

(3) Cap tube ends immediately after cleaning and until tube is to be installed on engine to prevent entry of foreign matter.

EMERGENCY FUEL SHUTOFF SYSTEM - DESCRIPTION AND OPERATION

1. General (Ref. Figs. 1and 2)

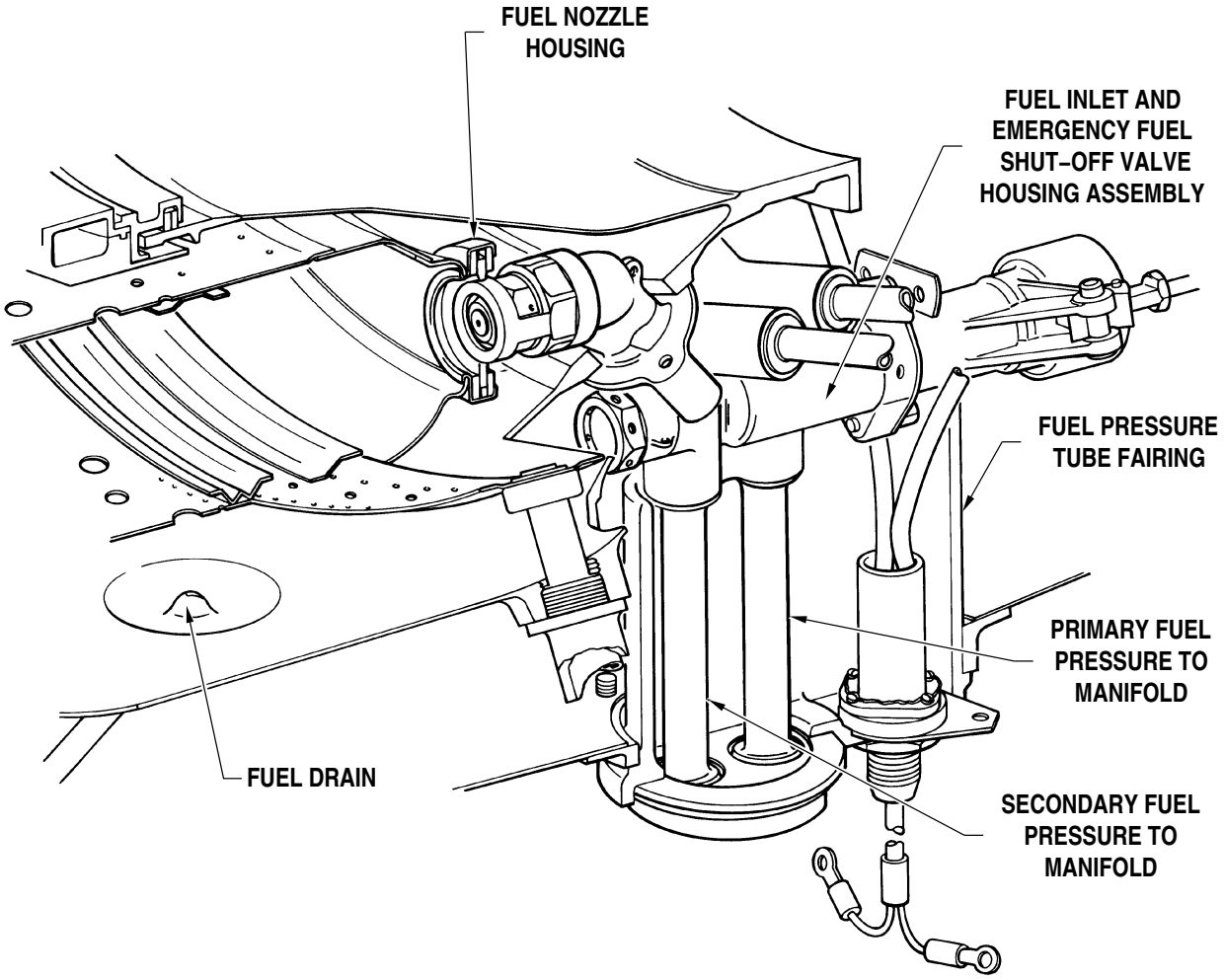
   A fuel supply automatic shutoff system is provided. An automatic tripping mechanism installed on the No.4 bearing housing is linked to the fuel inlet and shutoff valve assembly on the fuel manifold adapter (Ref. 72-50-06) by a wire rope and bellcrank arrangement. Axial rearward displacement of the LP turbine shaft will operate the system to shut off the fuel supply to the manifold and thus prevent a possible overspeed of the LP turbine assembly.

2. Emergency Fuel Shutoff System (Ref. Fig. 2)

   Pressure fuel passes to the primary and secondary nozzles through drillings in the inlet manifold body by way of ports (1) and (2) in the shutoff valve piston assembly (3). A set of spring washers (4) which bear on the smaller (forward) end of the piston assembly, keeps it firmly butted at the rear end against the head of the release plate (5) which is restrained from moving by shoulders formed on the inner faces of two pivoted overspeed control levers (6). These levers are prevented from moving apart by a counterbore in the head of the cup-shaped tripper sleeve assembly (7) which engages the tips of the levers. Mating mirror-image profiles on the inner faces of the levers afford clearance for a pin (10) installed diametrically across the open end of the tripper sleeve. A lug formed on the head of the sleeve projects rearwards through the cover to connect with a lever (11) which forms the final element of a mechanical linkage between the shutoff valve and overspeed actuating rod (12) installed in the No.4 bearing housing cover.

   Axial rearward displacement of the turbine shaft acts through the mechanical linkage to draw the tripper sleeve towards the rear, against the compression spring. If this movement exceeds the permitted amount, the counterbore of the tripper is drawn clear of the tips of the levers. At the same time, the sleeve pin, riding up the cam surfaces of the release levers, rotates the levers on their pivots, allowing the release plate to pass between them as the piston moves to the rear under the action of spring tension and fuel pressure. Displacement of this piston carries the ports out of register with the fuel passages in the manifold inlet, substituting a second pair of ports which are closed at the outlet side by valves (13). Fuel pressure on the stems of the valves presses them firmly against the open ends of the fuel delivery passages to cut off the flow to the manifold.

   The shutoff valve is not self-resetting.


FUEL NOZZLE HOUSING
FUEL INLET AND EMERGENCY FUEL SHUT–OFF VALVE HOUSING ASSEMBLY
FUEL PRESSURE TUBE FAIRING
PRIMARY FUEL PRESSURE TO MANIFOLD
SECONDARY FUEL PRESSURE TO MANIFOLD
FUEL DRAIN
C6986

Emergency Fuel Shutoff Valve (Typical)
Figure 1

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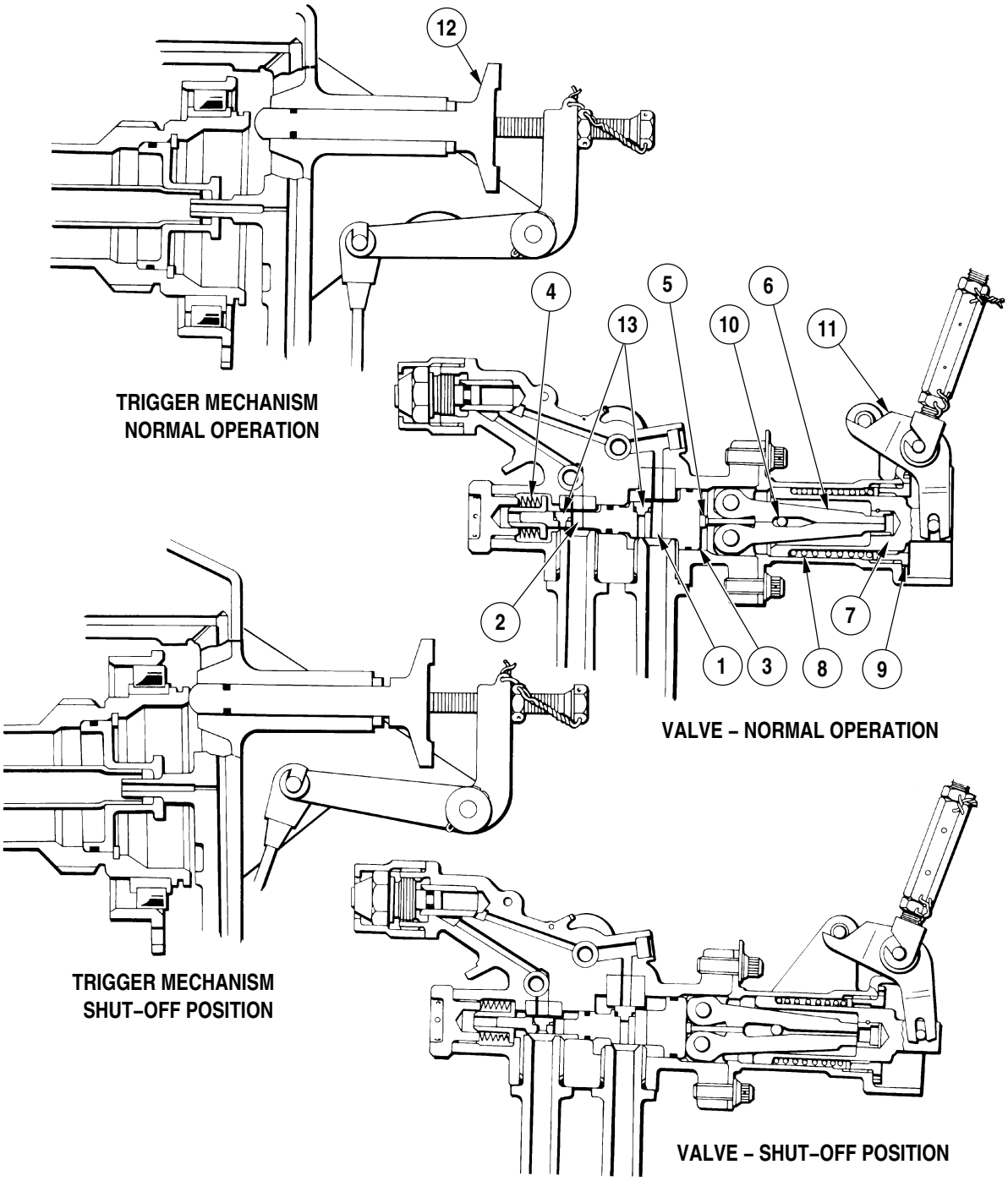


C19044

Emergency Fuel Shutoff Valve Action
Figure 2

Key to Figure 2

1. Primary Fuel Port
2. Secondary Fuel Port
3. Piston Assembly
4. Spring Washers
5. Release Plate
6. Control Lever
7. Tripper Assembly
8. Spring
9. Cover
10. Pin
11. Lever
12. Overspeed Actuating Rod
13. Valve

EMERGENCY FUEL SHUTOFF - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the emergency fuel shutoff control linkage.

2. Consumable Materials

   Not Applicable

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation (Heavy Maintenance Only)

   A. Removal of Emergency Fuel Shutoff Control Linkage (Ref. Fig. 201).

      NOTE: If emergency fuel shutoff control linkage adjustment is disturbed for any reason, overspeed tripper lug/tripper housing clearances must be readjusted to limits specified in step B., following.

      (1) Remove lockwire from linkage assembly (14). Loosen jam nuts (4) to expand rod.

      (2) Remove pin (2) from bellcrank (1) and rod-end bearing (3).

         NOTE: Shutoff valve linkage is sufficiently disconnected after step (2) to allow for removal of exhaust duct.

      (3) Remove cotterpin (7), washer (8) and pin (12). Discard cotterpin.

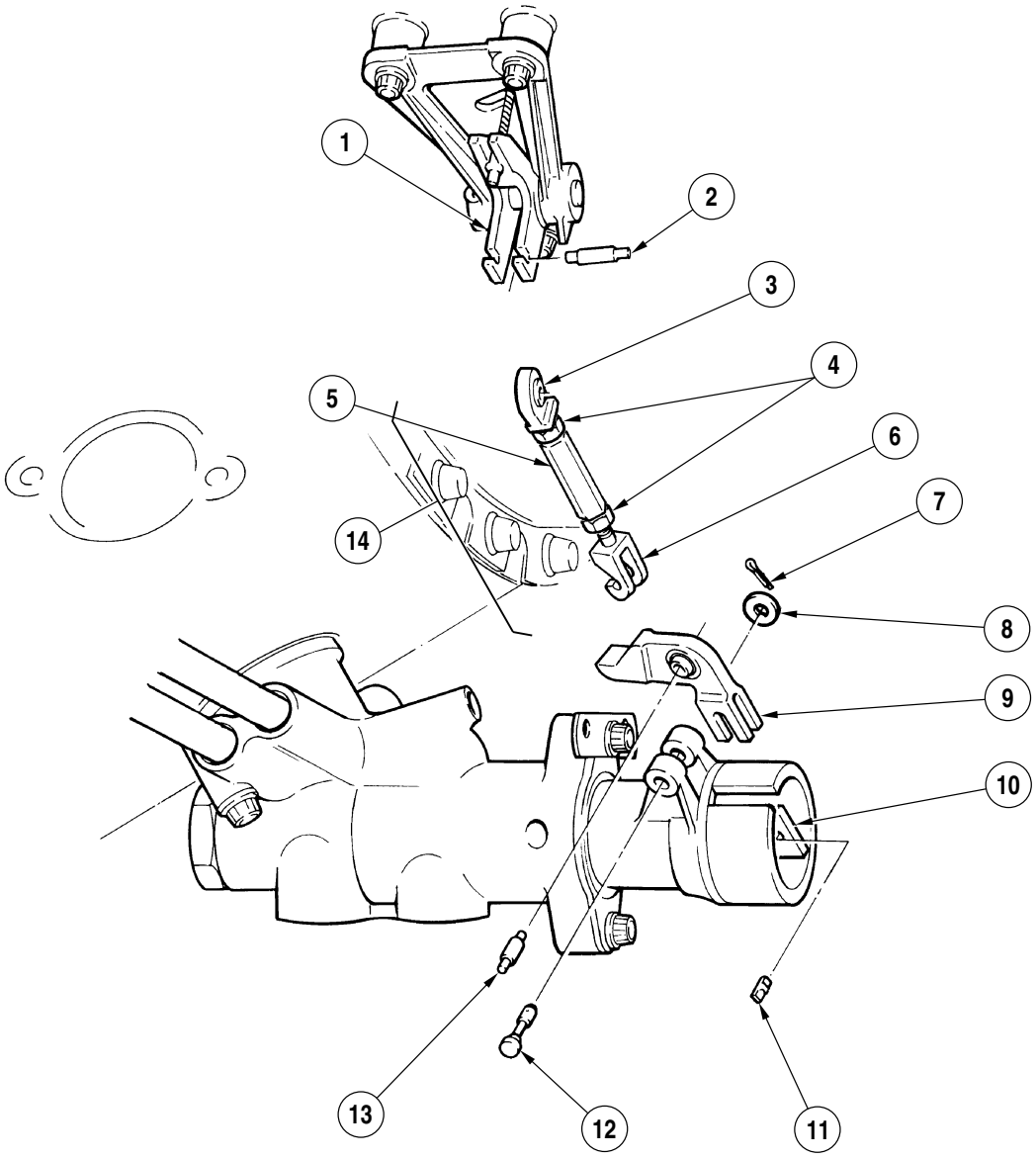
      (4) Remove pin (13) securing lever (9) to clevis (6). Remove linkage assembly (14).

      (5) Remove pin (11) securing lever (9) to overspeed tripper lug (10). Remove lever and pin.

   B. Installation of Emergency Fuel Shutoff Control Linkage (Ref. Fig. 201)

      CAUTION: ENSURE OVERSPEED CONTROL SHUTOFF VALVE IS CORRECTLY SET PRIOR TO INSTALLING OVERSPEED CONTROL LINKAGE.

      (1) If required, assemble overspeed control linkage assembly (14) as follows:

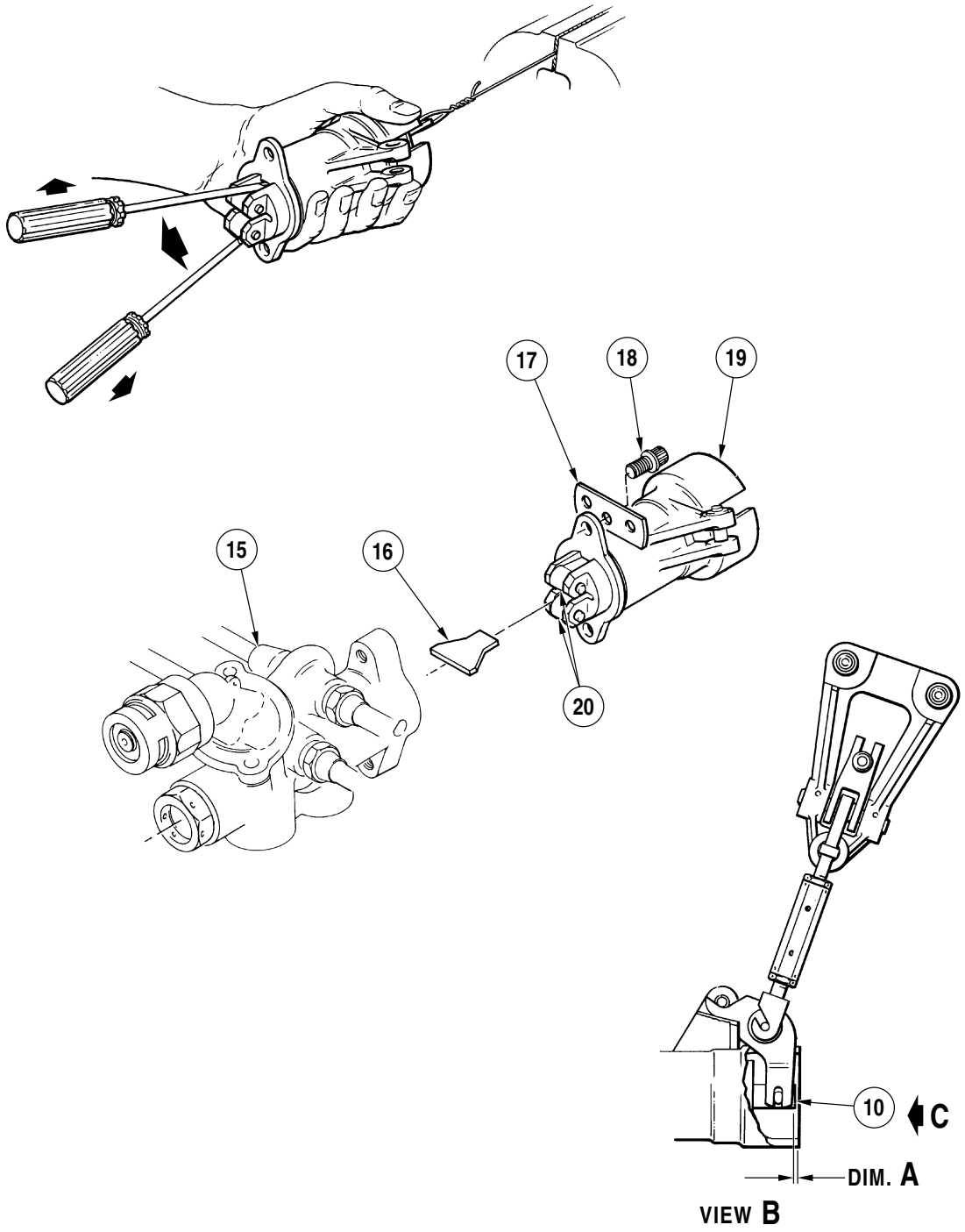


C18801

Removal/Installation of Emergency Fuel Shutoff System
Figure 201 (Sheet 1 of 2)

Key to Figure 201

1. Bellcrank
2. Headless Shoulder Pin
3. Rod-end Bearing
4. Jam Nut
5. Threaded Rod
6. Rod-end Clevis
7. Cotterpin
8. Washer
9. Overspeed Control Lever
10. Overspeed Tripper Lug
11. Headless Shoulder Pin
12. Straight Pin
13. Headless Shoulder Pin
14. Linkage Assembly
15. Fuel Inlet and Shutoff Valve Housing Assembly
16. Fuel Shutoff Valve Release Plate
17. T6 Thermocouple Leads Bracket
18. Bolt
19. Overspeed Control Linkage Housing (Tripper)
20. Overspeed Tripper Control Levers



C18800

Removal/Installation of Emergency Fuel Shutoff System
Figure 201 (Sheet 2)

(a) Install rod-end clevis (6) and jam nut (4) in left-hand threaded hole of rod (5). Install rod-end bearing (3) and jam nut (4) in right-hand threaded hole in rod (5).

NOTE: Thread rod-end clevis and rod-end bearing into rod an equal number of turns.

(b) Tighten jam nuts (4) fingertight.

(2) Secure rod-end bearing (3) to bellcrank (1) by installing pin (2) through eye of bearing and fitting in bellcrank slot.

(3) Install pin (13) in eye of lever (9).

(4) Install lever (9) and pin (13) in connecting rod assembly clevis (6).

(5) Secure clevis of lever (9) to overspeed tripper lug (10) with pin (11). Loosen jam nuts (4) and adjust threaded rod (5) if required.

(6) Install pin (12) through eyes of tripper mounting bracket over flat part of lever (9). Loosen jam nuts (4) and adjust threaded rod (5) if required.

(7) Secure pin (12) with washer (8) and cotterpin (7).

(8) Ensure that jam nuts (4) are fingertight.

CAUTION: OVERSPEED CONTROL LINKAGE ASSEMBLY MUST BE CORRECTLY INSTALLED AND LOCKWIRED BEFORE CONTINUING TO ASSEMBLE ENGINE. THE FOLLOWING PROCEDURES MUST BE FOLLOWED.

(9) Adjust and secure overspeed control linkage as follows:

(a) Lightly tap overspeed tripper lug (10) in direction C. Tighten threaded rod (5) to achieve Dimension A clearance of 0.012 to 0.016 in. between rear face of tripper (19) body and overspeed tripper lug. Torque jam nuts (4) 32 to 36 lb.in.

(b) Measure Dimension A again. If not within 0.012 to 0.016 inch, loosen jam nuts (4) and adjust threaded rod (5).

(c) After establishing correct Dimension A, torque jam nuts (4) 32 to 36 lb.in.

(d) Lockwire threaded rod (5) to jam nuts (4), then lockwire rod-end bearing (3) and clevis (6) to respective jam nuts.

(e) Measure Dimension A again. If not within 0.012 to 0.016 inch, remove lockwire, loosen jam nuts (4) and adjust threaded rod (5). Repeat steps (c) , (d) and (e) until correct Dimension A is achieved.

C. Removal/Resetting/Installation of Overspeed Control Linkage Housing (Tripper) (Ref. Fig. 201)

NOTE: 1. Any instance of engine shutdown due to operation of the emergency fuel shutoff valve must be fully investigated and the cause determined.

NOTE: 2. In the event of accidental operation, the fuel shutoff valve tripper can be reset as specified in this paragraph.

(1) Removal

(a) If shutoff valve has accidentally tripped, remove shutoff valve linkage (14) in accordance with Para. 5.A., steps (1) and (3) through (5).

(b) Remove two bolts (18) securing tripper (19) and T6 thermocouple leads bracket (17) to fuel inlet and shutoff valve housing. Remove tripper assembly.

(c) Collect unsecured release plate (16) located between pivoted ends of tripper (19).

D. Resetting Overspeed Control Linkage Housing (Tripper)

(1) Temporarily insert suitable short length of rod (rivet stem or similar) through hole in tripper sleeve actuating lug and attach loop of lockwire to provide a means of pulling on mechanism.

(2) With wire loop firmly gripped in bench vise and an assistant grasping the assembly, insert blades of two small screwdrivers into open end of housing so that flats of blades lie against outer edges of release levers.

(3) With the assistant bearing forward on housing to slightly remove tripper sleeve, press screwdrivers inwards levering handles gently outwards against edges of housing slots, thus applying pressure on levers to centralize them along assembly center line.

CAUTION: FOR THE FOLLOWING OPERATION, APPLY LIGHT PRESSURE ONLY TO AVOID DAMAGE TO HOUSING EDGE.

(4) Maintain continuing pressure on screwdrivers and direct the assistant to reduce pull on mechanism, thus allowing sleeve to move inwards slowly under spring pressure.

(5) During pull and release sequence of steps (3) and (4), preceding, levers should be felt to pivot inwards and sleeve move forward until its rear face lies below surface of housing cover. If this does not occur, repeat steps (3)and (4) by gentle backward and forward movement of housing while light pressure is maintained on levers until they can be felt to settle into place.

(6) When tripper mechanism has been reset, remove wire loop and temporary rod.

E. Installation of Overspeed Control Linkage Housing (Tripper)

(1) Insert narrow end of release plate (16) between pivoted ends of control levers (20). Install tripper assembly (19) with linkage at 10 o'clock position , ensuring that wide end of plate contacts piston installed in fuel inlet and shutoff valve housing (15).

(2) Insert two bolts (18), entering top bolt through bracket which supports T6 harness loop clamps. Torque bolts 32 to 36 lb.in. and lockwire.

(3) Install overspeed control linkage in accordance with Para. 5.A., step B..

F. Removal/Installation of Emergency Fuel Shutoff Valve

Removal of the emergency fuel shutoff valve components within the fuel inlet adapter and shutoff valve housing are required when replacing the inlet adapter or any fuel nozzle adapter, because of pressure check requirements. Refer to Chapter 73-10-05, MAINTENANCE PRACTICES.

6. Adjustment/Test

Refer to Adjustment/Test procedures (Ref. 73-10-05).

7. Inspection/Check

Refer to Inspection/Check procedures (Ref. 73-10-05).

8. Approved Repairs

Refer to Approved Repairs procedures (Ref. 73-10-05).

BLEED VALVE ACTUATOR - DESCRIPTION AND OPERATION

1. Bleed Valve Actuator (Ref. Fig. 1)

   A. Description

      The compressor bleed system comprises a bleed valve, bleed valve linkage, actuating rod a hydraulically operated actuator and an electrical circuit.

      The bleed valve actuator consists of a piston-type actuator, a pull-type solenoid, a double orifice pack and a pressure relief valve. The actuator has a flange which mounts between the fuel pump and the HMU. Passages in the flange allows the transfer of fuel supply and fuel drain flow between the fuel pump and the HMU. Fuel pressure tapped off these passages is utilized in the bleed actuator to position the actuator yoke.

      Supply pressure directed to the yoke side of the actuator piston tends to maintain the yoke in the retracted position. Modulated supply pressure, when directed to the piston face tends to extend the bleed actuator yoke.

      The orifice pack provides for a pressure drop at the relief valve output and between modulated supply pressure and drain pressure.

   B. Operation

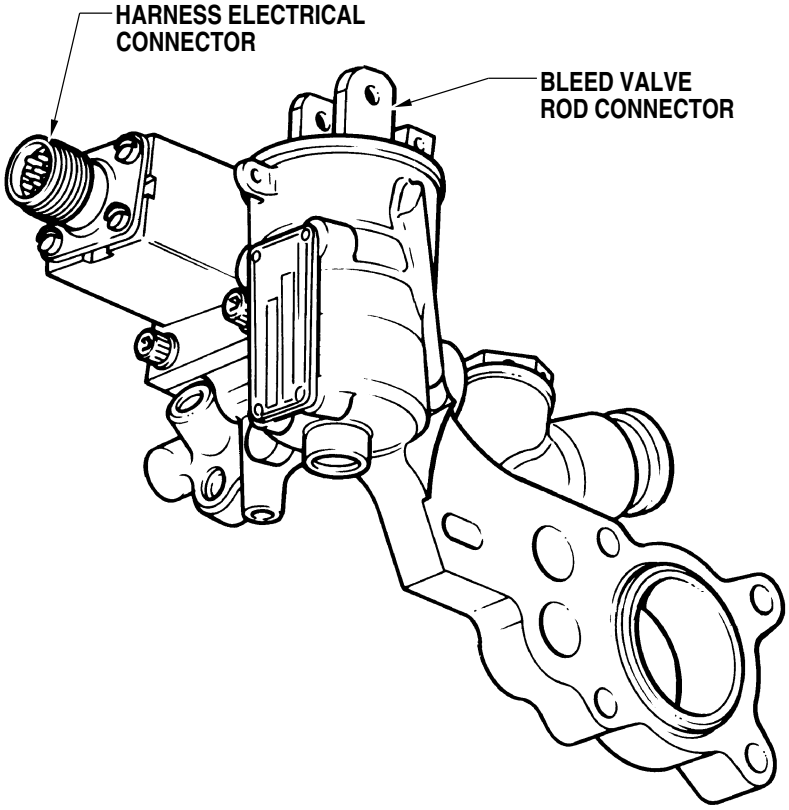
      In the bleed opening mode, the solenoid is energized by a signal from the engine electronic control (EEC) via the engine wiring harness. Fuel flows through the solenoid valve to the actuator piston face and through the inboard orifice back to drain. Because solenoid modulated pressure is essentially supply pressure, total force on the piston face exceeds the opposing force (due to greater area) and so the net force on the piston extends the yoke to the open bleed position.

      When closed, the solenoid valve and pressure relief valve prevents the fuel supply pressure from reaching the piston face.

      The orifice pack provides for a pressure drop at the relief valve output and between modulated supply pressure and drain pressure.

      In the bleed closed mode, the solenoid is OFF (de-energized) and so (modulated) supply pressure is shut-off from the piston which then senses drain pressure (Pd) via the inboard orifice. Since the yoke side of piston is connected to supply pressure the net force on the piston retracts the yoke to the bleed closed position.

      The actuating yoke reacting force is limited by means of a pressure relief valve and orifice in series. When the differential pressure across the piston exceeds a preset value, the pressure relief valve opens permitting some of the supply pressure to flow through the outboard orifice to the piston face.



C11561

Bleed Valve Actuator (Typical)
Figure 1

BLEED VALVE ACTUATOR - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the bleed valve actuator.

2. Consumable Materials

   Not Applicable

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal

      (1) Remove assembled HMU, bleed valve actuator and fuel pump from mounting pad on accessory gearbox (Ref. 73-20-02).

      (2) Separate HMU, bleed valve actuator and fuel pump on a bench.

   B. Installation

      (1) Assemble and install HMU bleed valve actuator and fuel pump (Ref. 73-20-02).

      (2) If a replacement bleed valve actuator was installed:

         (a) Perform bleed valve rigging procedure (Ref. 72-30-07, Adjustment/Test).

         (b) Perform required ground checks (Ref. 71-00-00, ADJUSTMENT/TEST, Ground Testing).

FUEL FILTER AND IMPENDING BYPASS SWITCH - DESCRIPTION AND OPERATION

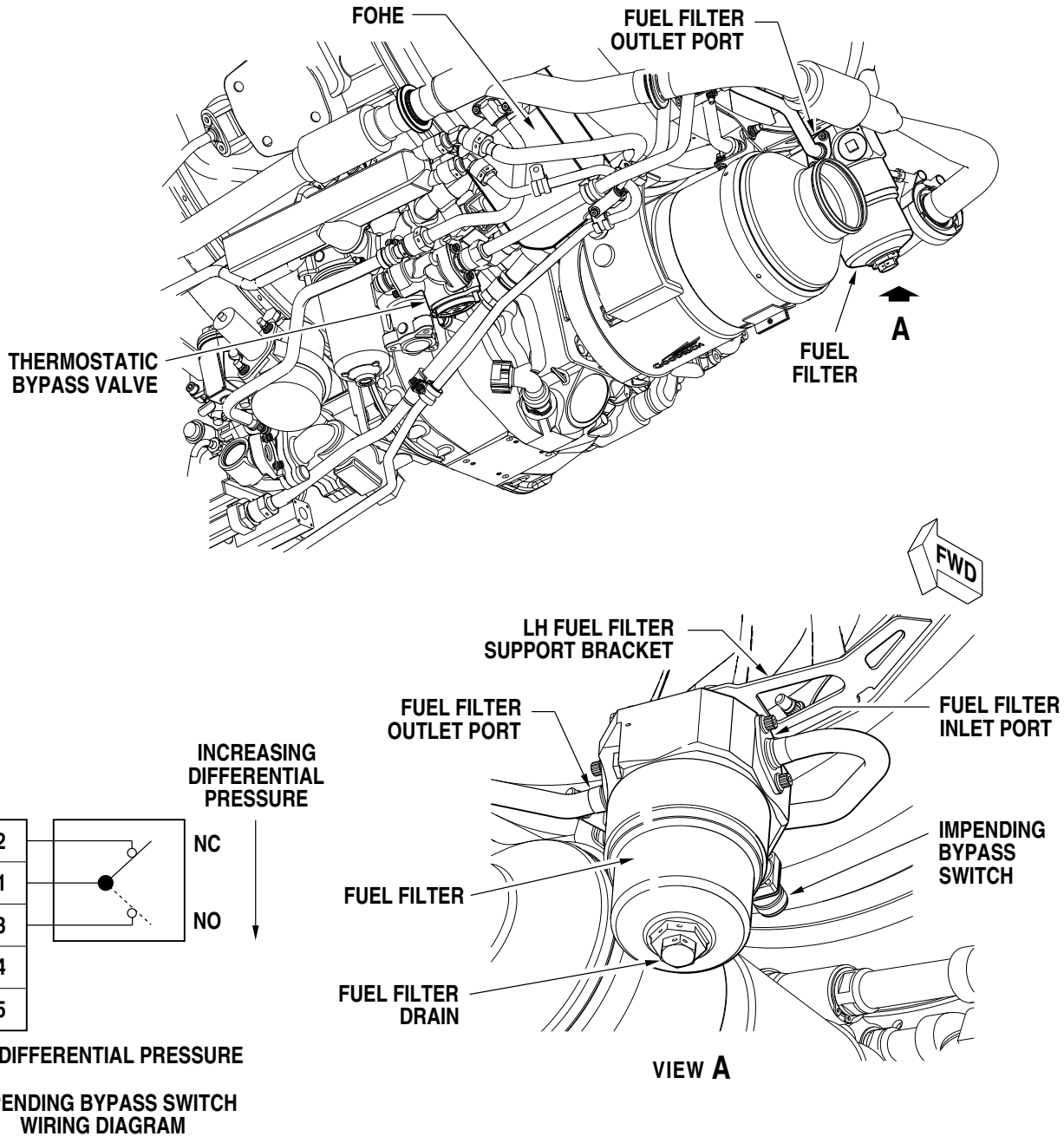
1. Fuel Filter and Impending Bypass Switch (JT15D-5R Engines) (Ref. Fig. 1)

   A. The low pressure fuel filter is a 40 micron filter mounted on the front of the low compressor case. It has an impending bypass switch mounted on the cover. The filter can be installed on either side of the engine, using a different support bracket for each location.

   B. The assembly comprises a removable filter housing that contains a disposable fuel filter element. The filter cover has a fuel filter bypass valve. Fuel from the Fuel/Oil Heat Exchanger (FOHE) enters an inlet boss on the cover. The outlet boss sends fuel to the thermal element of the thermostatic bypass valve (located in the oil filter housing). There are different fuel tubes for left and right engine installations.

   C. The spring-loaded filter bypass valve is installed in the cover of the filter and is normally closed. In the event of filter blockage, increased pressure overcomes the bypass valve spring force and opens the valve to permit an unrestricted, unfiltered fuel flow.

   D. The impending bypass switch is a replaceable unit mounted on a boss in the cover of the fuel filter. An airframe wiring harness connects to the switch. The switch actuates when the differential pressure between the fuel filter inlet port and the fuel filter outlet port reaches 11.0 ±1.5 psid. It will reset when the pressure drops to 7.0 psid minimum.



JT15D-5R Only C108699

Fuel Filter and Impending Bypass Valve
Figure 1

FUEL FILTER AND IMPENDING BYPASS SWITCH (JT15D-5R) - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the JT15D-5R fuel filter and impending bypass switch.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Engine Lubricating Oil
PWC05-344	Safety Cable

3. Special Tools

   The special tools listed below are used in the following procedures.

Tool No.	Name
PWC90025	Crimper, Safety Cable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal of the Fuel Filter (Ref. Fig. 201)

      (1) Put a container under the filter (4).

      WARNING: BEFORE BREAKING ANY ELECTRICAL CONNECTIONS, ENSURE ELECTRICAL POWER SUPPLY IS CUT OFF. REFER TO AIRFRAME MAINTENANCE MANUAL.

      (2) Disconnect the aircraft electrical connector from the impending bypass switch (7) (Ref. Aircraft Maintenance Manual).

      (3) Cut and remove the safety cable from the drain plug (6).

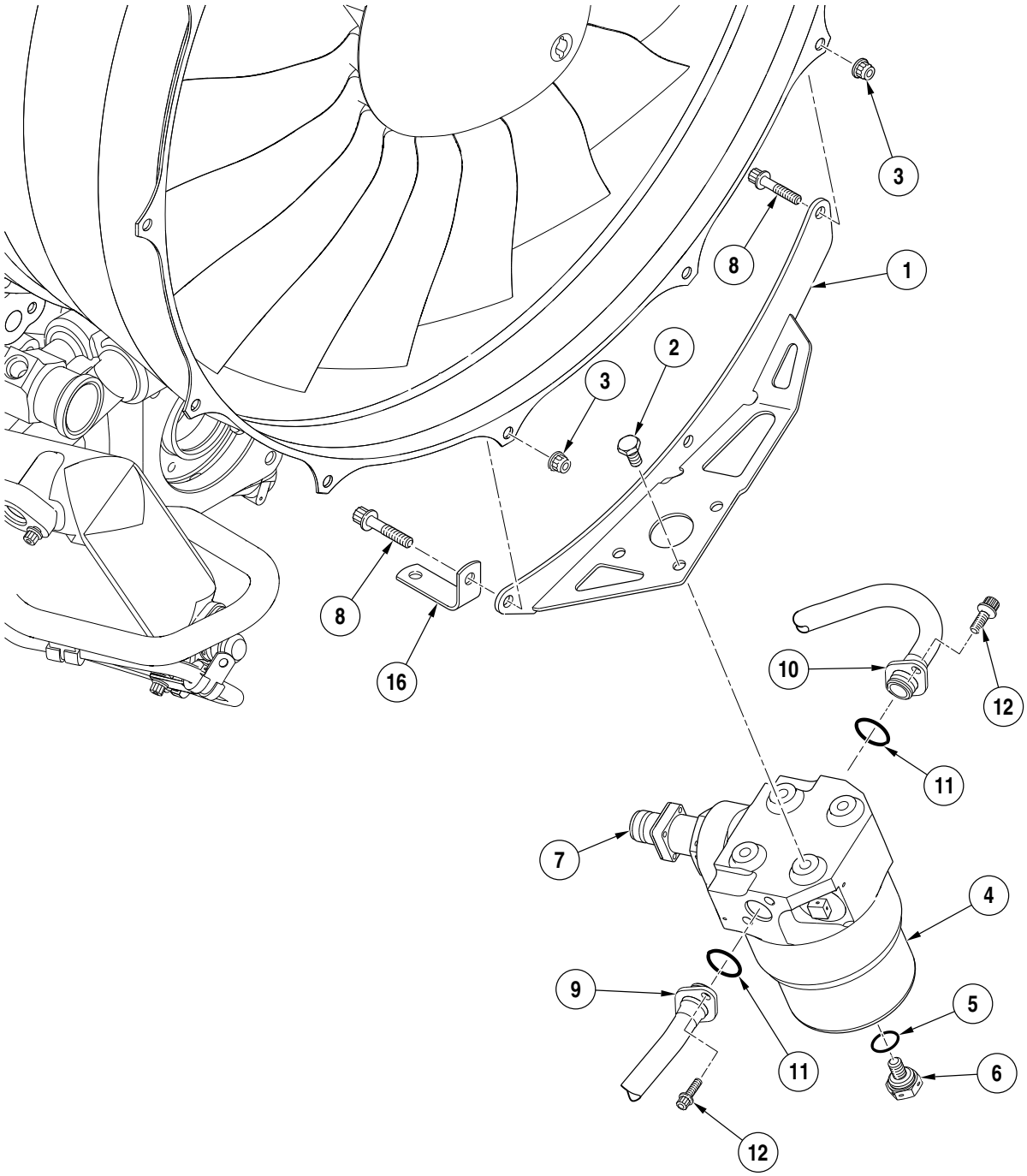
      (4) Remove the drain plug (6) from the bottom of the fuel filter (4). Let the residual fuel drain into the container.

      (5) Remove the preformed packing (5) from the drain plug. Discard the packing.

      (6) For a left engine installation, remove the fuel tubes (9) and (10) (Ref. 73-10-01).

      (7) For a right engine installation, remove the fuel tubes (13) and (14) (Ref. 73-10-01).

      (8) Remove the bolts (2) that attach the fuel filter (4) to the support bracket (1) or (15). Remove the filter.

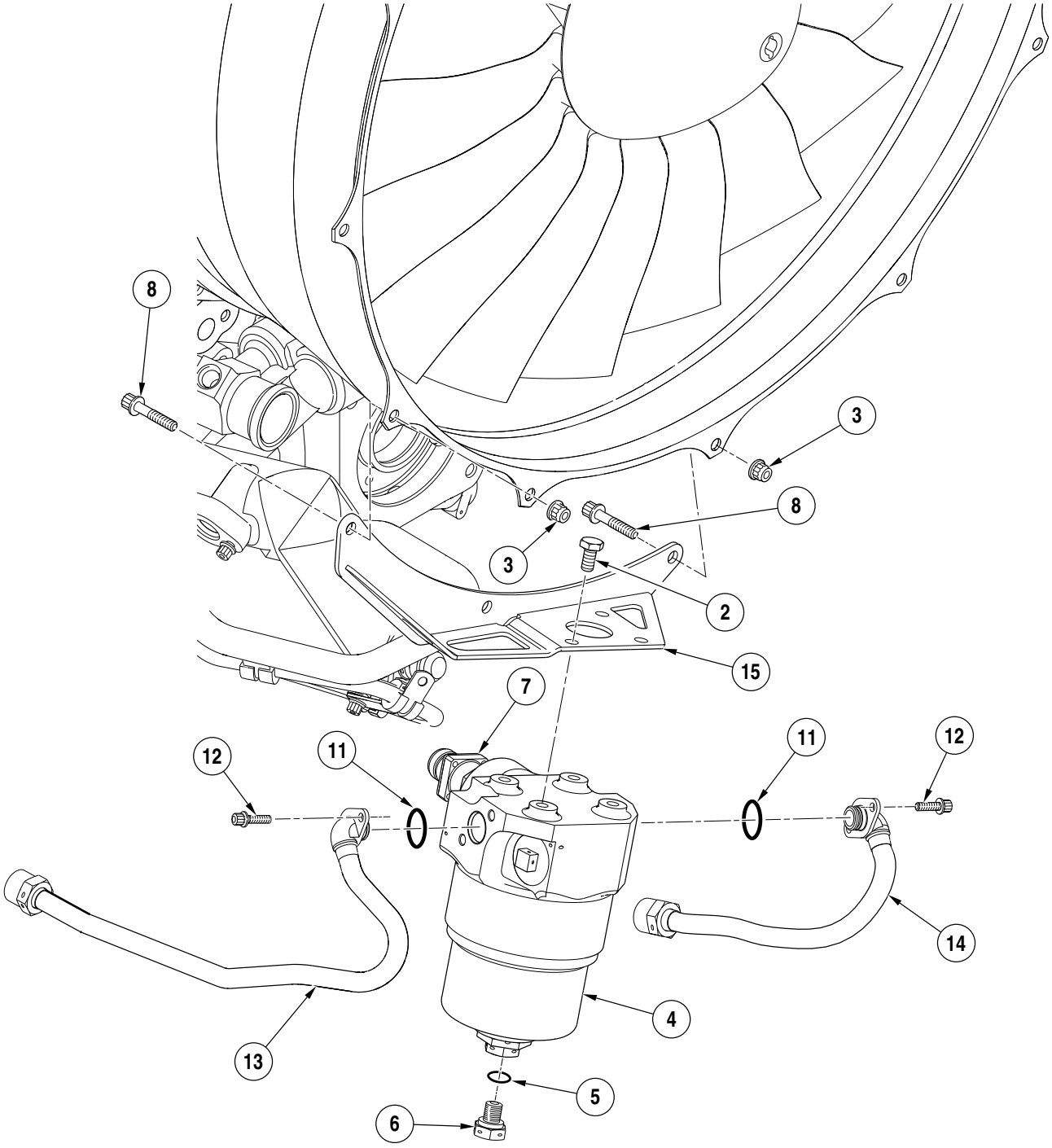


JT15D-5R Left Engine Installation C108697

Removal/Installation - Fuel Filter
Figure 201 (Sheet 1 of 2)

Key to Figure 201

1. LH Fuel Filter Support Bracket
2. Bolt
3. Nut
4. Fuel Filter
5. Preformed Packing
6. Drain Plug
7. Impending Bypass Switch
8. Bolt
9. LH Filter-to-Oil Housing Fuel Tube
10. LH Heater-to-Filter Fuel Tube
11. Preformed Packing
12. Bolt
13. RH Filter-to-Oil Housing Fuel Tube
14. RH Heater-to-Filter Fuel Tube
15. RH Fuel Filter Support Bracket



JT15D-5R Right Engine Installation C109077

Removal/Installation - Fuel Filter
Figure 201 (Sheet 2)

(9) If you are changing the engine from a left engine installation to a right engine installation, or vice versa, remove the bolts (8), nuts (3) and the applicable support bracket (1) or (15).

(10) Install protective caps and plugs on disconnected component openings.

B. Installation of the Fuel Filter (Ref. Fig. 201)

(1) Remove the protective caps and plugs from disconnected component openings.

(2) Lubricate preformed packings (4) and (11) and all threads with a light film of engine oil (PWC03-001).

(3) For a right engine installation, install the support bracket (15) on the engine with three bolts (8) and nuts (3). Torque the nuts (3) 85 to 95 lbf.in.

(4) For a left engine installation, install the support bracket (1) on the engine with three bolts (8) and nuts (3). Torque the nuts (3) 85 to 95 lbf.in.

(5) Install the fuel filter (4) on the support bracket (1) or (15) with three bolts (2). Torque the bolts (2) 85 to 95 lbf.in.

(6) Install new preformed packings (11) on the fuel tubes (9) and (10) or (13) and (14) as applicable.

(7) Install the fuel tubes (9) and (10) or (13) and (14) as applicable (Ref. 73-10-01).

(8) Install the drain plug (6) in the bottom of the fuel filter (4). Torque 40 to 60 lbf.in.

(9) Lock the drain plug (6) to the fuel filter (4) with safety cable (PWC05-344) using crimper (PWC90025).

WARNING: BEFORE MAKING ANY ELECTRICAL CONNECTIONS, ENSURE ELECTRICAL POWER SUPPLY IS CUT OFF. REFER TO AIRFRAME MAINTENANCE MANUAL.

(10) Connect the aircraft electrical connector to the impending bypass switch (7) (Ref. Aircraft Maintenance Manual).

C. Removal of the Impending Bypass Switch (Ref. Fig. 202)

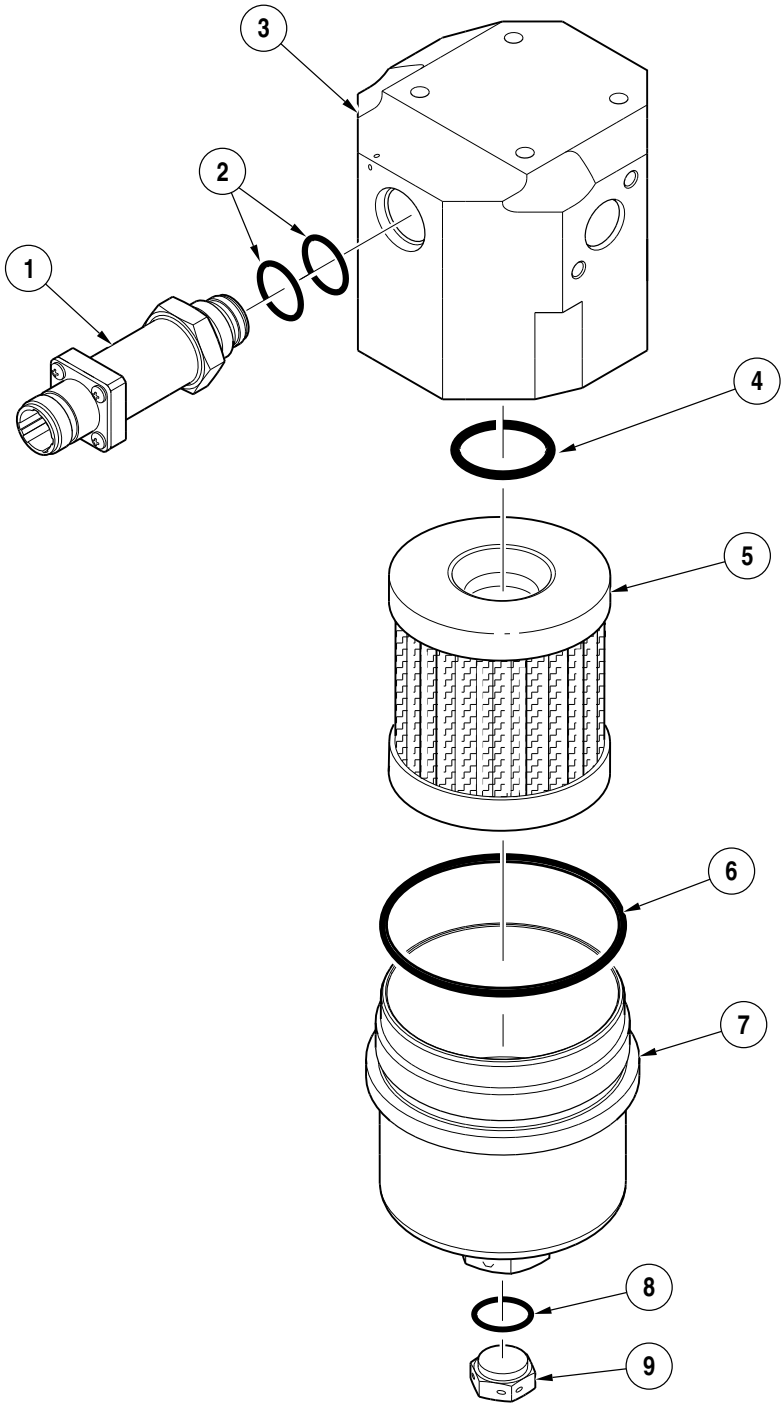
(1) Put a container under the fuel filter.

WARNING: BEFORE BREAKING ANY ELECTRICAL CONNECTIONS, ENSURE ELECTRICAL POWER SUPPLY IS CUT OFF. REFER TO AIRFRAME MAINTENANCE MANUAL.

(2) If the fuel filter is installed on the engine, disconnect the aircraft electrical connector from the impending bypass switch (1).

(3) Cut and remove the lockwire from the impending bypass switch (1) to the fuel filter (3).

(4) Remove the impending bypass switch (1) from the fuel filter (3).



JT15D-5R Engines Only C108698

Removal/Installation - Fuel Filter Element and Impending Bypass Switch
Figure 202

Key to Figure 202

1. Impending Bypass Switch
2. Preformed Packing
3. Fuel Filter
4. Preformed Packing
5. Fuel Filter Element
6. Preformed Packing
7. Fuel Filter Bowl
8. Preformed Packing
9. Drain Plug

(5) Remove the preformed packings (2) from the impending bypass switch (1). Discard the packings.

D. Installation of the Impending Bypass Switch (Ref. Fig. 202)

(1) Lubricate preformed packings (2) and all threads with a light film of engine oil (PWC03-001).

(2) Install new preformed packings (2) on the impending bypass switch (1).

(3) Install the impending bypass switch (1) in the fuel filter (3).

(4) Torque the impending bypass switch (1) 20 to 30 lbf.in. and lockwire.

WARNING: BEFORE MAKING ANY ELECTRICAL CONNECTIONS, ENSURE ELECTRICAL POWER SUPPLY IS CUT OFF. REFER TO AIRFRAME MAINTENANCE MANUAL.

(5) If the fuel filter is installed on the engine, connect the aircraft electrical connector to the impending bypass switch (1).

E. Removal of the Fuel Filter Element (Ref. Fig. 202)

CAUTION: THE FUEL FILTER ELEMENT IS DISPOSABLE AND MUST BE DISCARDED. DO NOT CLEAN.

(1) Put a container under the fuel filter (3).

(2) Cut and remove the safety cable from the drain plug (9).

(3) Remove the drain plug (9) from the bottom of the fuel filter bowl (7). Let the residual fuel drain into the container.

(4) Remove the preformed packing (8) from the drain plug. Discard the packing.

(5) Remove the filter bowl (7) from the filter (3).

(6) Remove the filter element (5) and preformed packing (4) and discard the packing.

NOTE: If the fuel filter element is at its life limit (Ref. 72-00-00, ENGINE: TURBINE - INSPECTION), discard the filter.

(7) Remove the preformed packing (6) from the internal groove of the filter head (3) and discard.

(8) Inspect the fuel filter for debris or contamination (Ref. Para. 6.A.).

F. Installation of the Fuel Filter Element (Ref. Fig. 202)

CAUTION: THE FUEL FILTER ELEMENT IS DISPOSABLE AND MUST BE DISCARDED. DO NOT CLEAN.

(1) Lubricate preformed packings (4), (6), and (8) and all threads with a light film of engine oil (PWC03-001).

(2) Install a new preformed packing (4) in the filter element (5).

(3) Install a new preformed packing (6) in the internal groove of the filter head (3).

(4) Install the filter element (5) in the filter head (3).

(5) Position the filter bowl (7) over the end of the filter element (5) and screw the filter bowl into the fuel filter head (3). Seat the filter bowl (7). Torque the filter bowl 120 to 180 lbf.in.

(6) Install the preformed packing (8) on the drain plug.

(7) Install the drain plug (9) in the bottom of the fuel filter bowl (7). Torque 40 to 60 lbf.in.

(8) Lock the drain plug (9) to the filter bowl (7) with safety cable (PWC05-344) using crimper (PWC90025).

6. Inspection/Check

NOTE: For periodic inspection requirements refer to Periodic Inspection table in Chapter 72-00-00.

A. Fuel Filter Element

(1) Inspect the fuel filter element for debris, contamination, or damage.

(2) If debris or contamination is evident do the steps that follow:

(a) Record the amount and physical appearance of the debris or contamination in the engine logbook.

(b) Collect the debris in a clean container, then determine composition of debris.

(c) Determine the source of the debris or contamination (Ref. Aircraft Maintenance Manual).

(d) If the fuel filter was in an impending or full bypass condition do the steps that follow:

1 Remove the Fuel/Oil Heat Exchanger (FOHE) (Ref. 73-10-14) and send it to an approved overhaul facility for cleaning.

2 After cleaning, re-install the FOHE (Ref. 73-10-14).

(3) For filters with debris, contamination or damage, discard the fuel filter element.

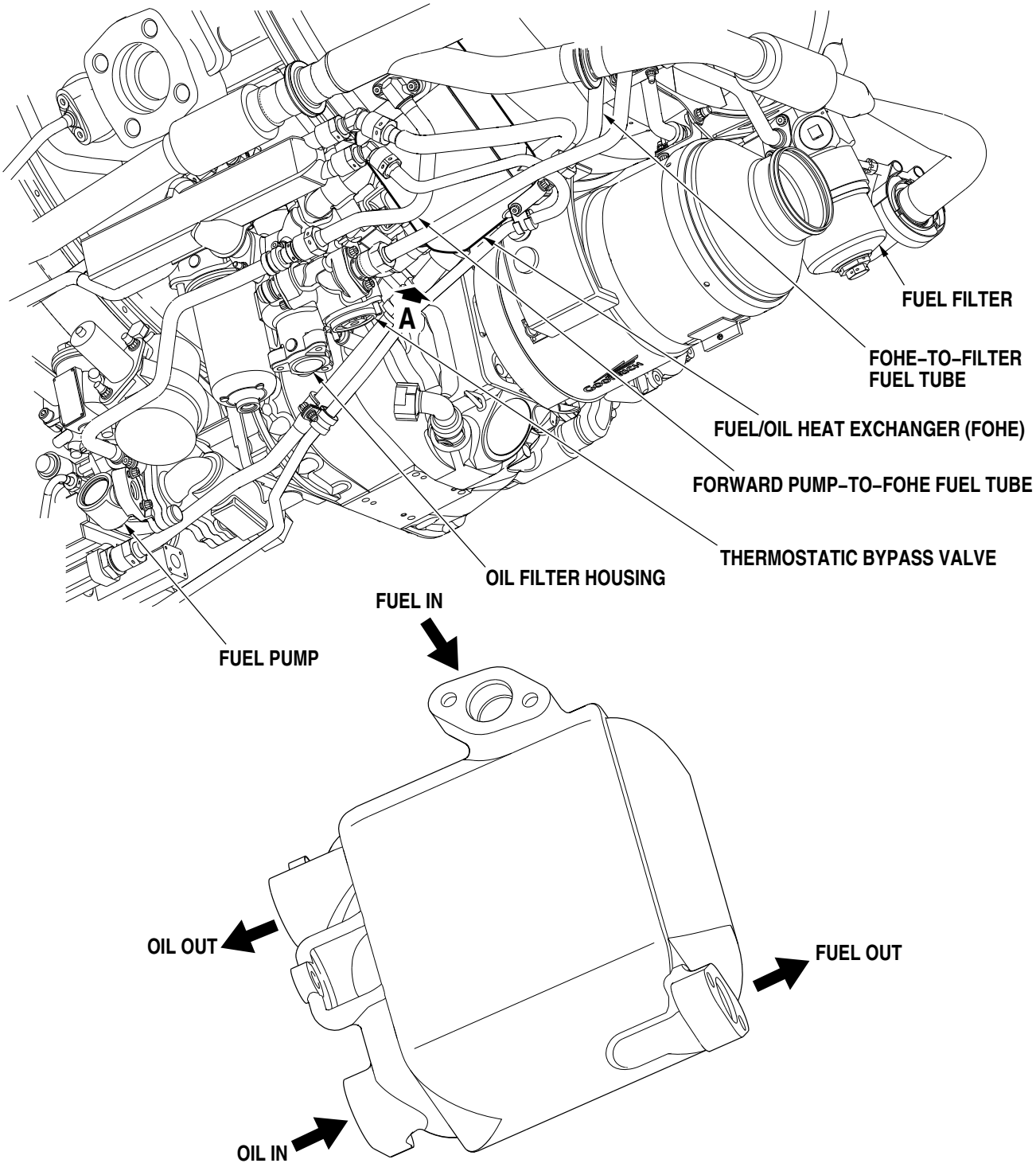
FUEL/OIL HEAT EXCHANGER (JT15D-5R) - DESCRIPTION AND OPERATION

1. Fuel/Oil Heat Exchanger (FOHE) (Ref. Fig. 1)

   The fuel/oil heat exchanger is mounted to the oil filter housing on the right side of the engine. The FOHE transfers heat from the oil system to the low pressure fuel from the centrifugal stage of the fuel pump.

   Fuel to the engine goes to the two-stage fuel pump. After the fuel leaves the centrifugal stage, it leaves the pump and goes to the inlet side of the FOHE. The fuel is heated by the oil that flows through the FOHE from the oil filter housing. The heated fuel then leaves the FOHE and goes through the fuel filter. The fuel is then routed through a thermal element in the oil filter housing.

   The thermal element is part of a Thermostatic Bypass Valve (TBV) in the oil filter housing. The TBV controls the flow of oil to the heat exchanger. If the fuel through the thermal element is too hot the TBV blocks the oil to the FOHE until the fuel cools. The oil is delivered to the FOHE through transfer tubes between the FOHE and the oil filter housing.



Fuel/Oil Heat Exchanger (FOHE)
Figure 1

FUEL/OIL HEAT EXCHANGER (JT15D-5R) - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the Fuel/Oil Heat Exchanger (FOHE) and the FOHE heat shield.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Engine Lubricating Oil

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal of Fuel/Oil Heat Exchanger (FOHE) (Ref. Fig. 201)

      (1) Put a container under the engine.

      (2) Remove the flowmeter-to-oil cooler fuel tube and oil cooler-to-FDV fuel tube (Ref. 73-10-01).

      (3) Remove the FOHE-to-filter fuel tube (10) and the forward pump-to-FOHE fuel tube (4) (Ref. 73-10-01).

      (4) Remove the FOHE heat shield (12) (Ref. Para. C.)

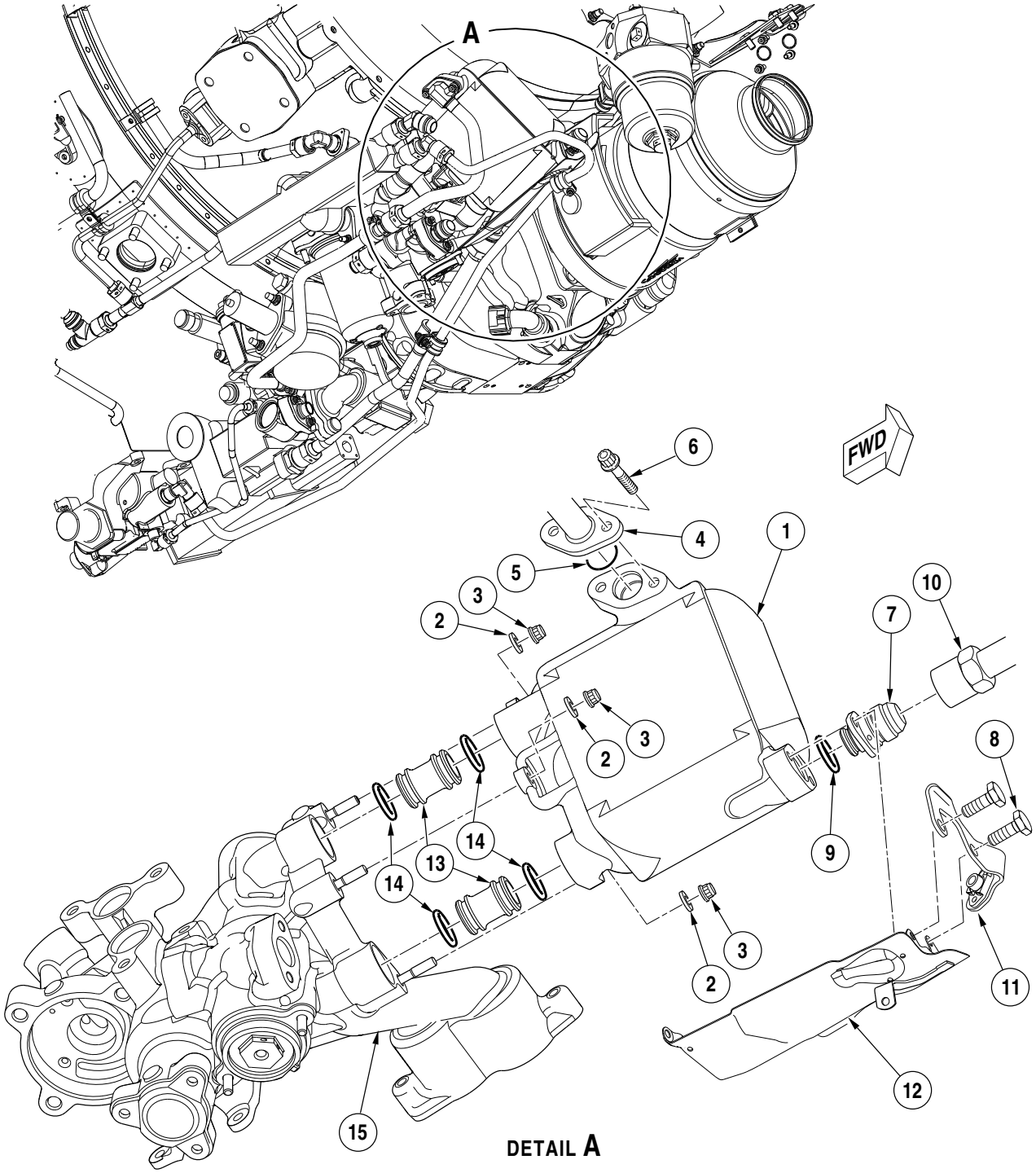
      (5) If you are replacing the FOHE (1) remove the two bolts (8) and the straight adapter (7) from the FOHE (1). Remove and discard the preformed packing (9) from the straight adapter.

      (6) Remove the three nuts (3) and washers (2) from the FOHE (1).

      (7) Carefully withdraw the FOHE (1) from the oil filter housing (15).

      (8) Remove the two transfer tubes (13) from the FOHE (1) or oil filter housing (15) as applicable. Remove and discard the preformed packings (14) from the transfer tubes (13).

      (9) Install protective caps and plugs on disconnected component openings.



JT15D-5R Only C108720

Removal/Installation - Fuel/Oil Heat Exchanger (FOHE)
Figure 201

Key to Figure 201

1. Fuel/Oil Heat Exchanger (FOHE)
2. Flat Washer
3. Self-locking Nut
4. Supply-to-Heater Fuel Tube
5. Preformed Packing
6. Bolt
7. Tube-to-Boss Straight Adapter
8. Bolt
9. Preformed Packing
10. Heater-to-Filter Fuel Tube
11. Bracket (Ref.)
12. FOHE Heat Shield (Ref.)
13. Transfer Tube
14. Preformed Packing
15. Oil Filter Housing (Ref.)

B. Installation of Fuel/Oil Heat Exchanger (FOHE) (Ref. Fig. 201)

(1) Remove the protective caps and plugs from disconnected component openings.

(2) Lubricate preformed packings (5), (9) and (14) with a light film of engine oil (PWC03-001).

(3) If applicable, install a new preformed packing (9) on the straight adapter (7). Install the straight adapter (7) on the FOHE (1) with two bolts (8).

NOTE: The bolts (8) and bracket (11) are installed with the FOHE heat shield (12).

(4) Install new preformed packings (14) on the transfer tubes (13).

(5) Install the transfer tubes (13) in the oil filter housing (15).

(6) Align the FOHE (1) with the transfer tubes (13) and install it on the oil filter housing (15) with the washers (2) and the nuts (3). Torque the nuts (3) 32 to 36 lbf.in.

(7) Install the FOHE heat shield (12) (Ref. Para. D.).

(8) Install the FOHE-to-filter fuel tube (10) and the forward pump-to -FOHE fuel tube (4) (Ref. 73-10-01).

(9) Install the flowmeter-to-oil cooler fuel tube and oil cooler-to-FDV fuel tube (Ref. 73-10-01).

C. Removal of the FOHE Heat Shield (Ref. Fig. 202)

(1) Remove the self-locking nut (7) and bolt (6) that attaches the loop clamp (5) to the bracket (8).

(2) Remove the bolt (2) that attaches the FOHE heat shield (1) and tube-to-boss straight adapter (4) to the oil filter housing (3).

(3) Remove the bolts (9) that attach the FOHE heat shield (1), bracket (10) and tube-to-boss straight adapter (12) to the FOHE (11).

(4) Carefully lower the forward end of the FOHE heat shield (1) until it clears the bracket (10). Remove the heat shield.

D. Installation of the FOHE Heat Shield (Ref. Fig. 202)

(1) Install the FOHE heat shield (1) on the FOHE (11).

(2) Attach the heat shield (1) to the tube-to-boss straight adapter (4) on the oil filter housing with the bolt (2). Torque the bolt (2) 36 to 40 lbf.in.

(3) Attach the the tube-to-boss straight adapter (12), heat shield (1) and bracket (10) to the FOHE (11) with the bolts (9). Torque the bolts (9) 36 to 40 lbf.in.

(4) Attach the loop clamp (5) to the heat shield bracket (8) with the bolt (6) and the nut (7). Torque the nut (7) 36 to 40 lbf.in.

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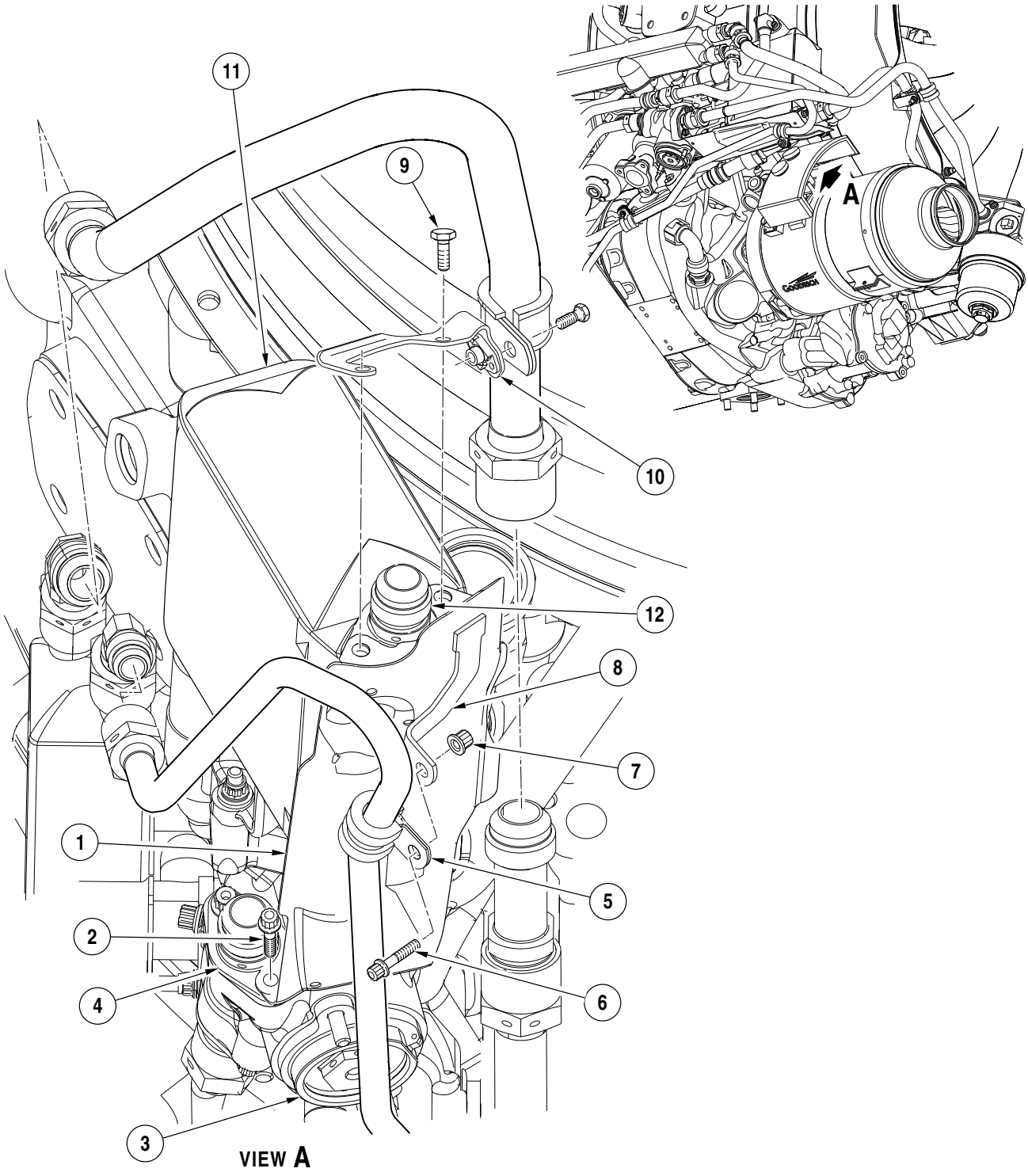

JT15D-5R Only C111391

Removal/Installation - FOHE Heat Shield
Figure 202

Key to Figure 202

1. FOHE Heat Shield
2. Bolt
3. Oil Filter Housing (Ref.)
4. Tube-to-Boss Straight Adapter
5. Loop Clamp
6. Bolt
7. Self-locking Nut
8. FOHE Heat Shield Bracket
9. Bolt
10. Bracket
11. Fuel/Oil Heat Exchanger (FOHE)
12. Tube-to-Boss Straight Adapter

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
LEP	1	Apr 04/2016
	2	Apr 04/2016
Contents	1	Apr 04/2016
	2	Apr 04/2016
	3	Apr 04/2016
	4	Apr 04/2016
73-20-02	1	Sep 28/2001
Description and	2	Sep 28/2001
Operation	3	Sep 28/2001
	4 blank	Sep 28/2001
73-20-02	101	Oct 22/99
Fault Isolation	102 blank	Oct 22/99
73-20-02	201	Feb 18/2011
Maintenance	202	Feb 18/2011
Practices	203	Feb 18/2011
	204	Feb 18/2011
	205	Feb 18/2011
	206	Feb 18/2011
	207	Feb 18/2011
	208	Feb 18/2011
	209	Feb 18/2011
	210	Feb 18/2011
	211	Feb 18/2011
	212	Feb 18/2011
	213	Feb 18/2011
	214 blank	Feb 18/2011
73-20-03	1	Oct 22/99
Description and	2	Oct 22/99
Operation	3	Oct 22/99
	4	Oct 22/99
	5	Oct 22/99
	6 blank	Oct 22/99
73-20-03	101	Oct 22/99
Fault Isolation	102 blank	Oct 22/99

CHAPTER SECTION	PAGE	DATE
73-20-03	201	Oct 06/2006
Maintenance	202	Oct 06/2006
Practices	203	Oct 06/2006
	204 blank	Oct 06/2006
73-20-04	1	Oct 22/99
Description and	2	Oct 22/99
Operation	3	Oct 22/99
	4	Oct 22/99
73-20-04	201	Apr 04/2016
Maintenance	202	Apr 04/2016
Practices	203	Apr 04/2016
	204	Apr 04/2016
	205	Apr 04/2016
	206	Apr 04/2016
	207	Apr 04/2016
	208	Apr 04/2016
	209	Apr 04/2016
	210	Apr 04/2016
	211	Apr 04/2016
	212	Apr 04/2016
	213	Apr 04/2016
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	218	Apr 04/2016
	219	Apr 04/2016
	220	Apr 04/2016
	221	Apr 04/2016
	222	Apr 04/2016
	223	Apr 04/2016
	224	Apr 04/2016
	225	Apr 04/2016
	226	Apr 04/2016
	227	Apr 04/2016
	228	Apr 04/2016

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LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
73-20-05	1	Oct 06/2006
Description and	2	Oct 06/2006
Operation	3	Oct 06/2006
	4 blank	Oct 06/2006
73-20-05	101	Oct 22/99
Fault Isolation	102 blank	Oct 22/99
73-20-05	201	Oct 06/2006
Maintenance	202	Oct 06/2006
Practices	203	Oct 06/2006
	204	Oct 06/2006
	205	Oct 06/2006
	206	Oct 06/2006
	207	Oct 06/2006
	208	Oct 06/2006
	209	Oct 06/2006
	210	Oct 06/2006
	211	Oct 06/2006
	212	Oct 06/2006
	213	Oct 06/2006
	214	Oct 06/2006
	215	Oct 06/2006
	216 blank	Oct 06/2006

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The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
HYDROMECHANICAL METERING UNIT - DESCRIPTION AND OPERATION	**73-20-02**
1. Description and Operation	1
A. General	1
B. Engine Control Linkage Installation	1
C. HMU Metering Function	1
D. Operation	1
E. Start and Idle	3
F. Normal Operation Fuel Flows	3
G. Engine Shutdown	3
HYDROMECHANICAL METERING UNIT - FAULT ISOLATION	**73-20-02**
1. Fault Isolation	101
HYDROMECHANICAL METERING UNIT - MAINTENANCE PRACTICES	**73-20-02**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal of HMU (JT15D-5)	201
B. Removal of HMU (JT15D-5R)	205
C. Installation of HMU (JT15D-5)	209
D. Installation of HMU (JT15D-5R)	211
6. Adjustment/Test	212
A. Procedure for Replacement HMU	212
7. Inspection/Check	213
A. Check of Mechanical Linkage	213

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
HYDROMECHANICAL METERING UNIT - MAINTENANCE PRACTICES (Cont'd)	**73-20-02**
B. Condensation Trap - Draining	213
ENGINE ELECTRONIC CONTROL - DESCRIPTION AND OPERATION	**73-20-03**
1. Engine Electronic Control , 2 and 3)	1
A. Description	1
B. EEC Analog Inputs	1
C. EEC Frequency Inputs	1
D. Other EEC Inputs	1
E. EEC Outputs	1
F. Operation)	3
ENGINE ELECTRONIC CONTROL - FAULT ISOLATION	**73-20-03**
1. Fault Isolation	101
ENGINE ELECTRONIC CONTROL - MAINTENANCE PRACTICES	**73-20-03**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal of Engine Electronic Control	201
B. Installation of Engine Electronic Control	201
6. Functional Check	203
7. Inspection/Check	203
ENGINE WIRING HARNESS - DESCRIPTION AND OPERATION	**73-20-04**
1. Engine Electrical Wiring Harness and 3)	1

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
ENGINE ELECTRICAL WIRING HARNESS - MAINTENANCE PRACTICES	**73-20-04**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal of Engine Wiring Harness	201
B. Installation of Engine Wiring Harness	208
6. Cleaning	228
A. Wiring Harness Connectors	228
7. Inspection/Check	228
SPEED AND TEMPERATURE SENSORS - DESCRIPTION AND OPERATION	**73-20-05**
1. Description	1
A. Rotor Speed Sensing System	1
B. N1 Speed Sensor	1
C. N2 Speed Sensors	1
D. To Temperature Sensor	1
2. Operation	1
A. N1 and N2 Speed Sensors	1
B. To Temperature Sensor	3
SPEED SENSORS - FAULT ISOLATION	**73-20-05**
1. Fault Isolation	101
SPEED AND TEMPERATURE SENSORS - MAINTENANCE PRACTICES	**73-20-05**
1. General	201

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
SPEED AND TEMPERATURE SENSORS - MAINTENANCE PRACTICES (Cont'd)	**73-20-05**
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal of LP Compressor Shaft (N1) Speed Sensor	201
B. Installation of LP Compressor Shaft (N1) Speed Sensor	201
C. Removal of HP Compressor Shaft (N2) Speed Sensors	203
D. Installation of HP Compressor Shaft (N2) Speed Sensor	205
E. Removal of To Temperature Sensor	207
F. Installation of To Temperature Sensor	207
6. Cleaning	207
A. Speed Sensors	207
B. To Temperature Sensor	209
7. Inspection/Check	209
A. Visual Inspection of Speed Sensors	209
B. Electrical Check of N1 Rotor Speed Sensor	210
C. Electrical Check of N2 Rotor Speed Sensors	210
D. Visual Inspection of To Temperature Sensor	210
E. Electrical Check of To Temperature Sensor	210
8. Fits, Clearances and Torque Loadings	213

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The export control classification with respect to this document is contained on the back of the title page.

HYDROMECHANICAL METERING UNIT - DESCRIPTION AND OPERATION

1. Description and Operation (Ref. Fig. 1)

   A. General

      The fuel control unit is a Hamilton Standard Model JFC-118-31 known specifically as a hydromechanical metering unit HMU). In conjunction with an engine electronic control (EEC), separately mounted on the LP compressor case, the HMU provides fuel scheduling for engine operation at all altitudes.

   B. Engine Control Linkage Installation

      The engine control linkage installation consists of a pilot's single power lever on the cabin control pedestal which, through the aircraft control linkage, imparts a push-pull action to the rotary valve in the hydromechanical metering unit (HMU). The single lever provides an engine operating range from cutoff to full power.

   C. HMU Metering Function

      The metering section of the HMU consists of a variable area rotary valve, positioned by the pilot's power lever, in a series/parallel system with a compressor delivery (Pc) servo-positioned valve. The pressure drop across the metering section is equal to that of a very small parallel flow path which consists of a torquemotor flapper valve in series with an orifice. The pressure drop across the flapper opening is held constant by a regulator which bypasses excess fuel pump delivery flow to a low pressure region of the fuel pump. Bimetallic washers are used in the regulator to compensate for fuel temperature variations and adjustment is provided to offset variations between engines. When the torquemotor flapper valve is closed and its flow is zero, the pressure drop across the metering section is equal to the regulated pressure drop across the flapper valve. When the flapper valve is open, the pressure drop across the metering section is equal to the regulated flapper valve pressure drop plus the drop across the orifice. Because the flapper valve area is proportional to the torquemotor current, the increment of metering section flow is also proportioned to current.

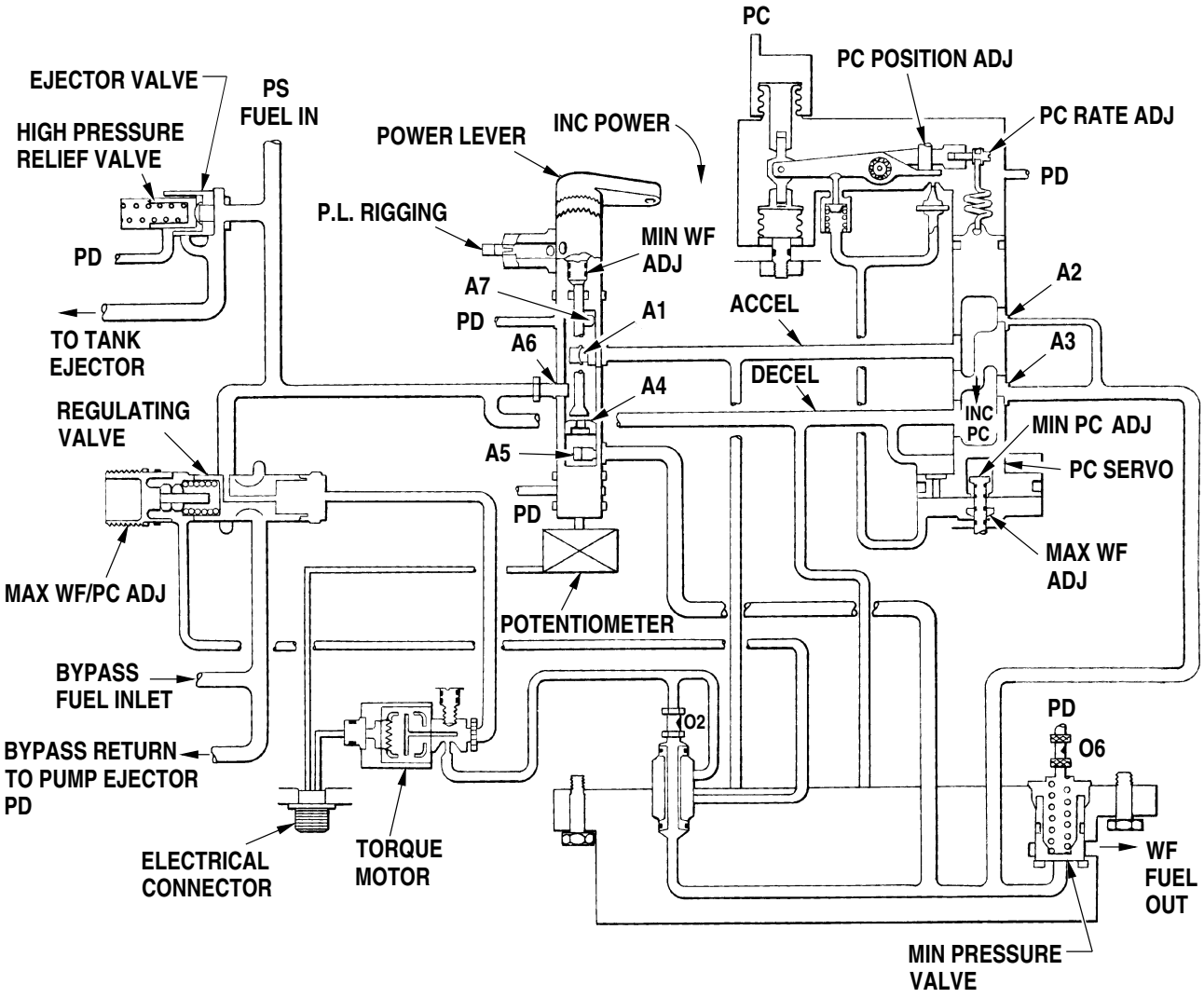
   D. Operation

      High pressure fuel from the engine-driven fuel pump enters the HMU passing through a combination ejector/high pressure relief valve. This valve establishes required pump output and returns flow in excess of engine computed requirements to the ejector valve; the remaining fuel passes to the:

      A. Power lever rotary valve
      B. Torquemotor flapper valve
      C. Compressor delivery air pressure (Pc) servo unit

      Engine fuel flow is scheduled by:

      A. Minimum flow adjustment
      B. Power lever rotary valve (Pl)
      C. Pc servo unit and sensor



LEGEND	
SYMBOL	DESCRIPTION
PS	SUPPLY PRESSURE
PD	DRAIN PRESSURE
PC	COMPRESSOR DISCHARGE PRESSURE
WF	METERED FUEL FLOW

C10798

Hydromechanical Metering Unit (HMU) Schematic
Figure 1

Both the rotary valve and Pc servo valve have hydraulic circuit windows in matched valve/sleeve combinations; thus, window areas control fuel flow. The window areas are determined by power lever angle (PLA), modified by the Pc sensor as a function of compressor delivery air pressure and, with the EEC in authority, are trimmed by the torquemotor flapper valve.

Valve windows are arranged in three circuits: mimimum flow circuit, acceleration circuit and deceleration circuit. The sum of the three circuits provide required engine fuel flow. Windows are identified as A1 through A7. Note that window A6 remains open while A7 is closed during normal power lever operation.

E. Start and Idle

Start and idle are scheduled and can be adjusted in the minimum flow circuit. With a PLA between zero and 15 degrees and with a compressor air delivery pressure of less than 40 psia, the rotary valve window A1 and Pc servo window A3 remain closed, shutting off the other acceleration and deceleration circuits. Minimum fuel flow is therefore through window A5 in series with adjustable orifice A4.

With a PLA of 15 degrees, Pc may exceed 40 psia and the Pc servo window A3 opens slightly allowing additional fuel as a function of compressor air delivery pressure. The sum of this additional flow and that of the minimum flow circuit schedules the 15 degrees PLA idle flow.

F. Normal Operation Fuel Flows

With the PLA increasing past 15 degrees, rotary valve window A1 commences to open. As A1 is in series with window A2 in the PC servo valve (whose area increases as compressor air delivery pressure rises), the sum of the flows through A1 and A2 result in fuel flows which are a function of Pc at various power lever angles.

Adding this acceleration circuit flow to that of the deceleration circuit produces the normal maximum fuel flow required at a PLA of 88 degrees. The power lever rotary valve can be manually rotated a further seven degrees to 95 degrees PLA, further increasing A1 window area and reopening window A5 to give higher fuel flows for emergency operation in the event of loss of EEC authority.

G. Engine Shutdown

The PLA is rotated to zero degrees, closing window A6 to shut off the minimum and acceleration flow circuits. The regulating valve senses a differential pressure as window A6 closes, causing it to increase bypass flow to the ejector valve. Windows A1 through A7 open to drain, exposing the downstream side of the Pc servo valve to drain pressure through windows A1, A2 and A7, increasing regulator valve opening.

With engine fuel flow dropping, compressor air delivery pressure falls off, allowing the Pc servo valve window A3 to close. This splits the deceleration circuit flow between the engine and windows A1, A2 and A7, causing a pressure drop to a value below that of the minimum pressurizing valve's crack open pressure. This allows spring loading to close the minimum pressurizing valve, creating a drop tight seal to the engine.

HYDROMECHANICAL METERING UNIT - FAULT ISOLATION

1. Fault Isolation

   For detailed fault isolation procedures for engine controls, refer to Chapter 72-00-00, FAULT ISOLATION, Fault Isolation for Engine Start Faults and Fault Isolation for Engine Operating Problems.

HYDROMECHANICAL METERING UNIT - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the hydromechanical metering unit.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Engine Lubricating Oil

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal of HMU (JT15D-5) (Ref. Fig. 201)

      NOTE: The HMU and bleed valve actuator are mounted on the fuel pump rear face. Remove fuel pump, bleed valve actuator and HMU as an assembly, then separate the components on a bench.

      (1) Disconnect wiring harness electrical connector (4) from HMU (5).

      (2) Disconnect airframe fuel system inlet tube from fuel pump (Ref. Airframe Maintenance Manual).

      (3) Disconnect airframe input linkage from HMU power lever (25)(Pre-SB7433 only) on HMU (3) (Ref. Airframe Maintenance Manual).

         NOTE: On Post-SB7433 engines, the power lever is airframe-supplied.

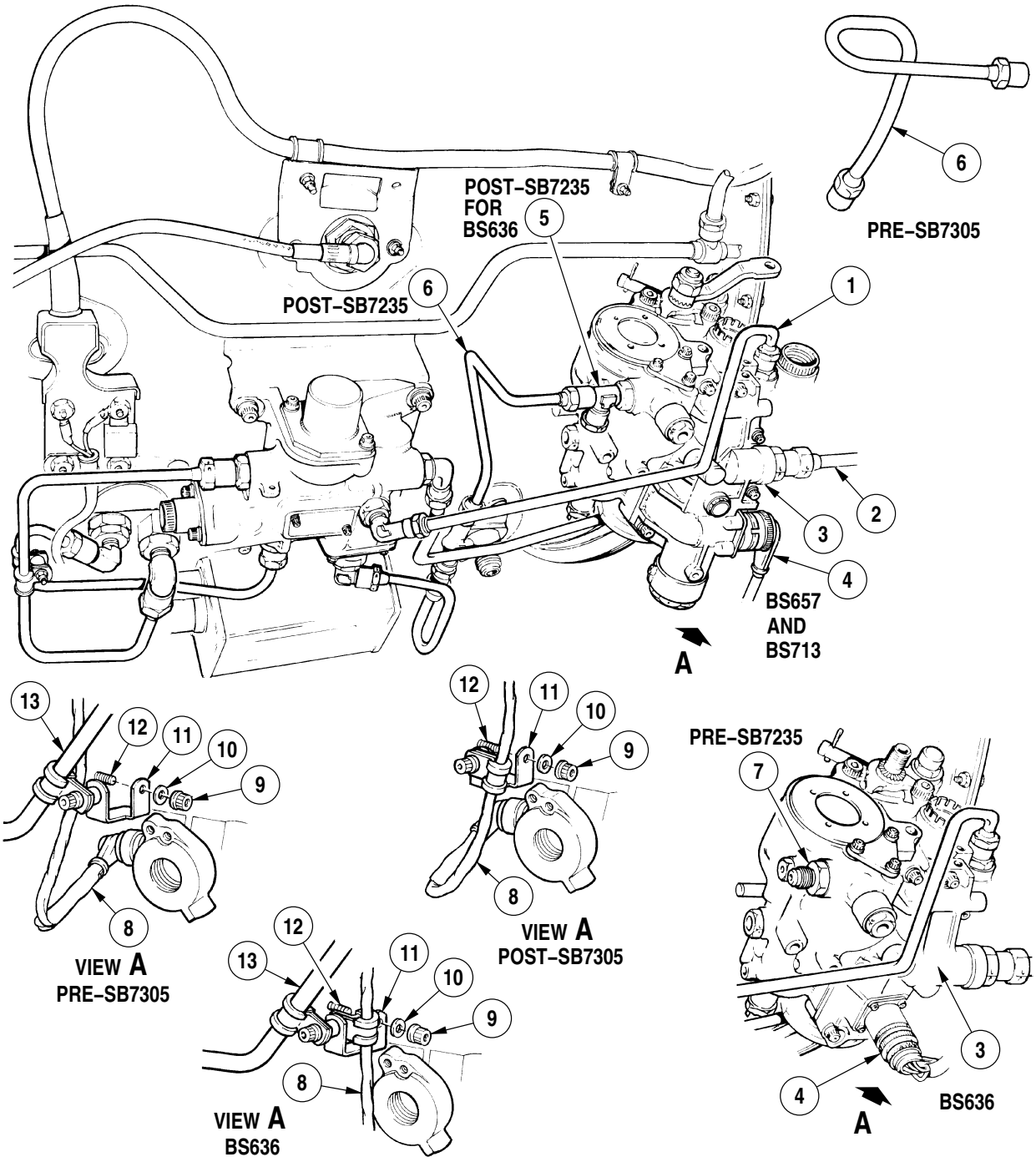
      (4) Remove self-locking nut (9) and washer (10). Remove bracket (11) from mounting stud (12) on fuel pump (14)(Ref. View A).

      (5) Disconnect wiring harness electrical connectors (4) and (27) from HMU (3) and bleed valve actuator (23).

      (6) Disconnect coupling nut on P3 air delivery tube (6) from nipple (7) or HMU tee fitting (5).

      (7) Disconnect coupling nut on bypass fuel tube (1) from HMU nipple (26).

      (8) Disconnect coupling nut on HMU-to-oil cooler pressure fuel tube (2) from HMU reducer (24).

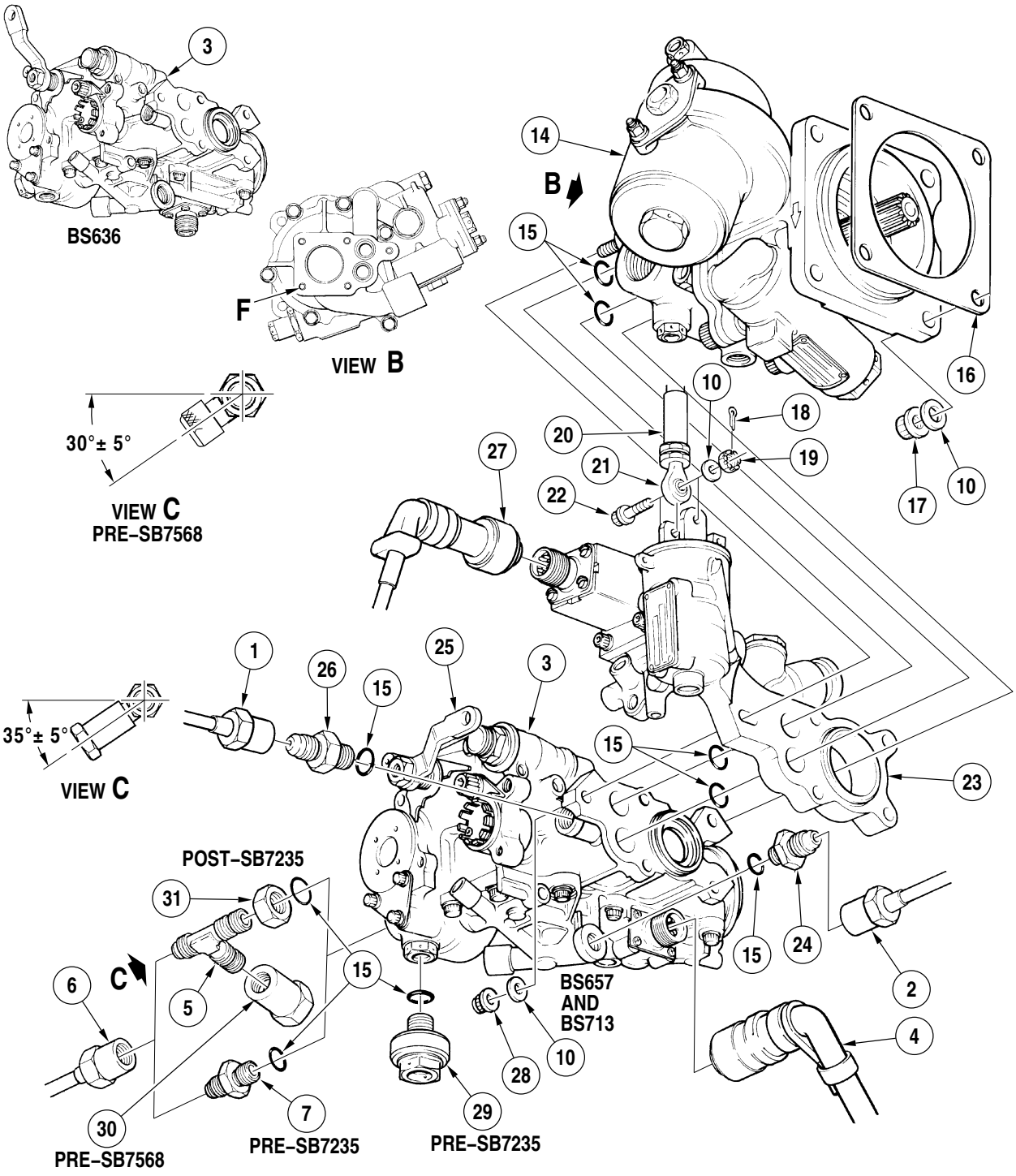


JT15D-5 Only C22107

Removal/Installation - HMU
Figure 201 (Sheet 1 of 2)

Key to Figure 201

1. Fuel Bypass Tube
2. HMU-to-Oil Cooler Pressure Fuel Tube
3. HMU
4. Wiring Harness HMU Electrical Connector
5. Tee Fitting
6. P3 Air Delivery Tube
7. Nipple
8. Wiring Harness HMU Connector Cable
9. Self-locking Nut
10. Washer
11. Bracket
12. Mounting Stud
13. Oil Cooler-to-Flow Divider Pressure Fuel Tube
14. Fuel Pump
15. Preformed Packing
16. Gasket
17. Self-locking Nut
18. Cotterpin
19. Castellated Nut
20. Bleed Valve Interconnect Rod
21. Rod-end Bearing
22. Bolt
23. Bleed Valve Actuator
24. Reducer
25. HMU Power Lever (Pre-SB7433 only)
26. Nipple
27. Bleed Valve Actuator Electrical Connector
28. Self-locking nut
29. Condensation Trap Pre-SB7235
30. Condensation Trap (Post-SB7235) (Pre-SB7568)
31. Jam Nut



C178207

Removal/Installation - HMU
Figure 201 (Sheet 2)

(9) Remove cotterpin (18), castellated nut (19), washer (10) and bolt (22) securing rod end bearing (21) to piston fork on bleed valve actuator (23).

(10) Remove four self-locking nuts (17) and washers (10) securing fuel pump (14) to accessory gearbox. Remove fuel pump, bleed valve actuator (23) and HMU (3) as an assembly. Remove and discard gasket (16).

(11) Remove four self-locking nuts (28) and washers (10) securing three units together. Separate the three units, and remove and discard four preformed packings (15).

(12) Install protective caps on units not to be replaced and store separately in suitable containers.

(13) If HMU is to be replaced, remove reducer (24), nipple (26), Pre-SB7235 condensation trap (29), Pre-SB7235 nipple (7) or Post-SB7235 tee fitting (5) with condensation trap (30), and preformed packings (15). Discard all packings.

NOTE: Unless required, do not remove condensation trap (30) from tee fitting (5).

(14) For Pre-SB7568: If HMU is to be replaced, remove tee fitting (5) with condensation trap (30), and preformed packings (15). Discard all packings.

NOTE: Unless required, do not remove condensation trap (30) from tee fitting (5).

(15) For Post-SB7568: If HMU is to be replaced, remove tee fitting (5) and preformed packings (15). Discard all packings.

B. Removal of HMU (JT15D-5R) (Ref. Fig. 202)

NOTE: The HMU and bleed valve actuator are mounted on the fuel pump rear face. Remove fuel pump, bleed valve actuator and HMU as an assembly, then separate the components on a bench.

(1) Disconnect wiring harness electrical connector (4) from HMU (5).

(2) Disconnect the airframe fuel system inlet tube from the fuel pump (14) (Ref. Airframe Maintenance Manual).

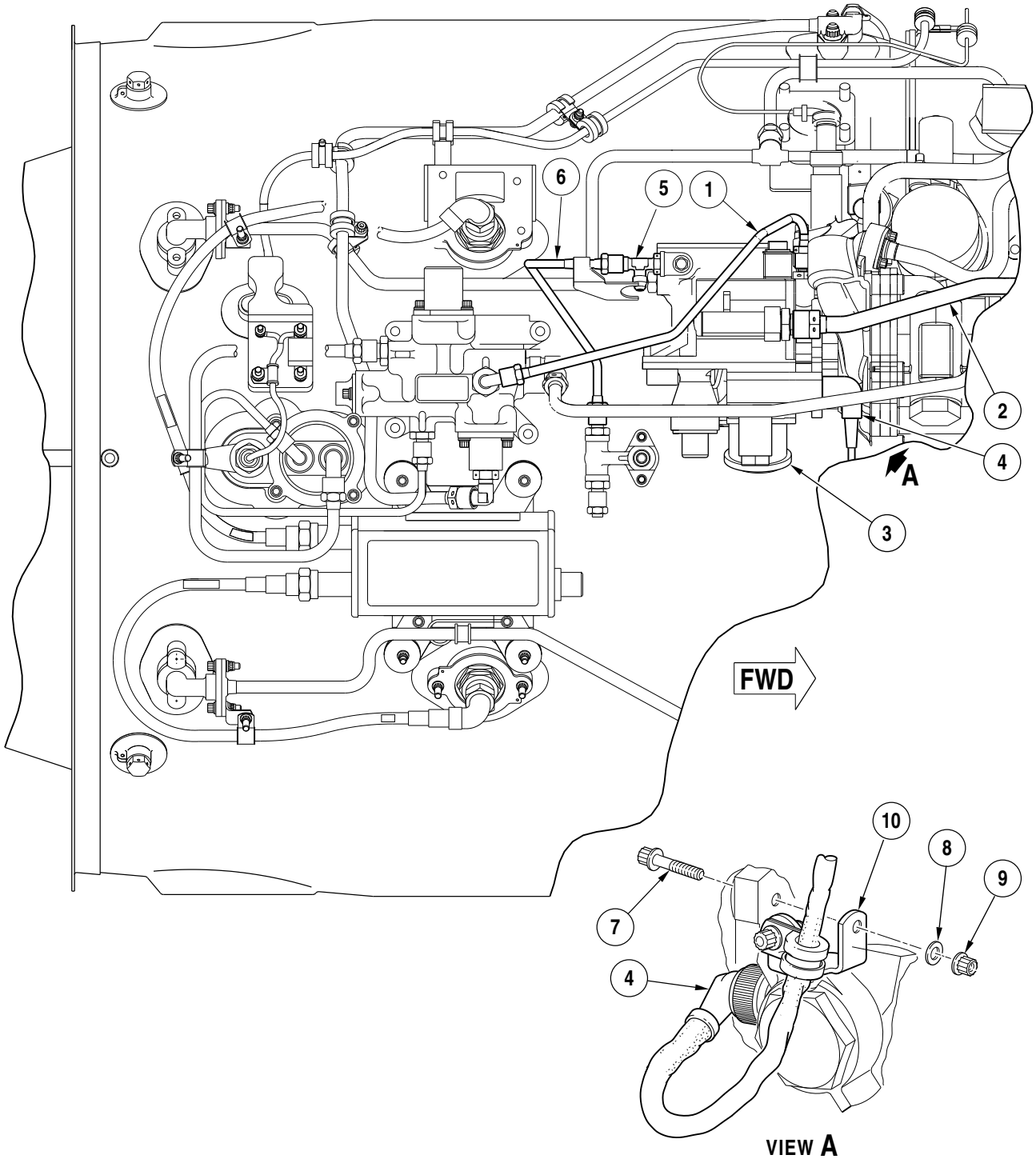
(3) Remove the bolts (12) and disconnect the tubes (11) and (14) from the fuel pump (14).

(4) Remove the preformed packings (13) from the tubes (11) and (14). Discard the packings.

(5) Disconnect airframe input linkage from HMU power lever on HMU (3) (Ref. Airframe Maintenance Manual).

(6) Remove the self-locking nut (9) and washer (8). Remove the bracket (10) from the mounting stud (7) on the fuel pump (14) (Ref. View A).

(7) Disconnect the wiring harness electrical connectors (4) and (27) from the HMU (3) and bleed valve actuator (23).



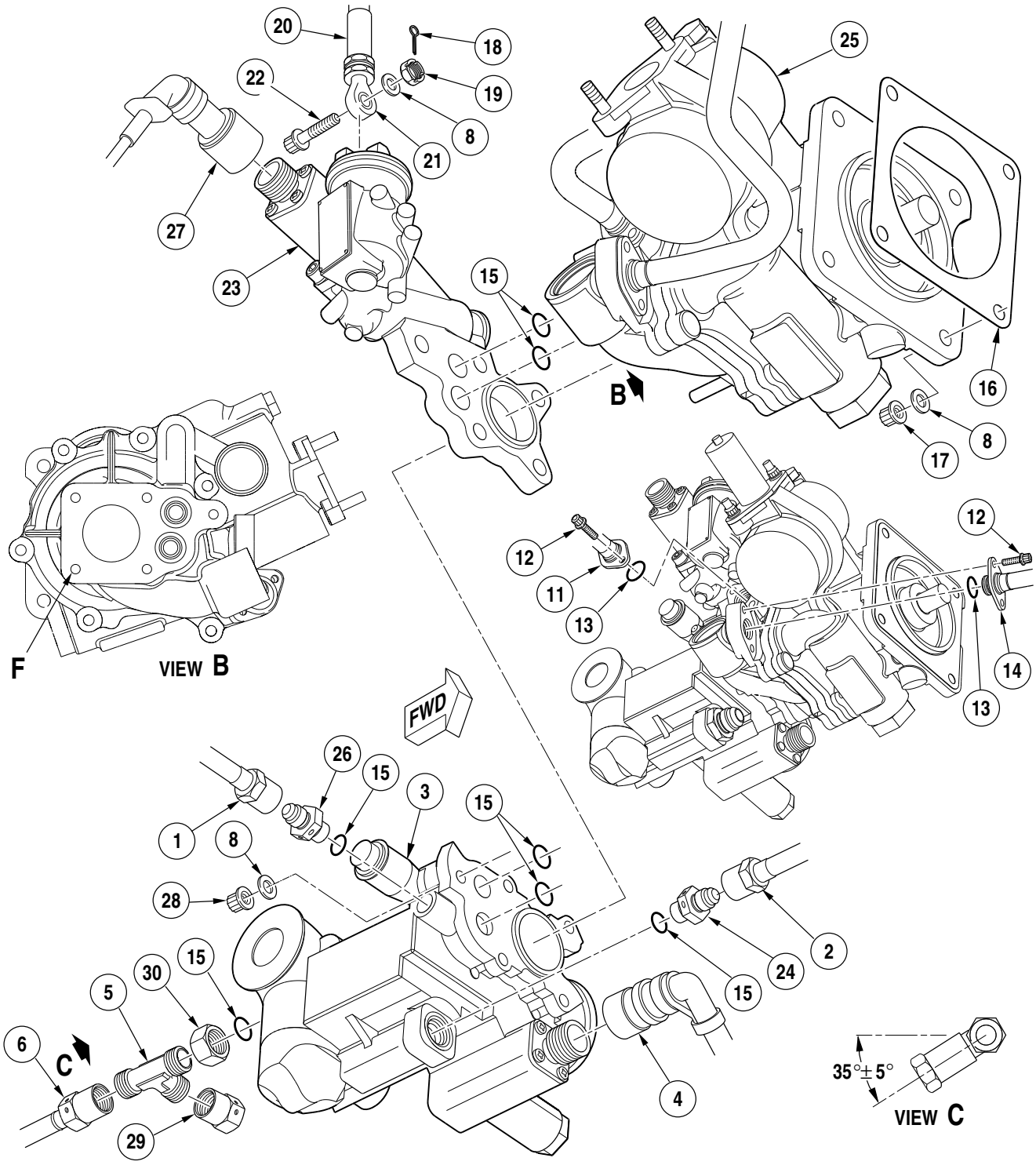
JT15D-5R Only

C108812

Removal/Installation - HMU
Figure 202 (Sheet 1 of 2)

Key to Figure 202

1. Fuel Bypass Tube
2. HMU-to-Oil Cooler Pressure Fuel Tube
3. HMU
4. Wiring Harness HMU Electrical Connector
5. Tee Fitting
6. P3 Air Delivery Tube
7. Mounting Stud (on HMU)
8. Washer
9. Self-locking Nut
10. Bracket
11. Supply-to-Heater Fuel Tube
12. Bolt
13. Preformed Packing
14. Return-to-Pump Fuel Tube
15. Preformed Packing
16. Gasket
17. Self-locking Nut
18. Cotterpin
19. Castellated Nut
20. Bleed Valve Interconnect Rod
21. Rod-end Bearing
22. Bolt
23. Bleed Valve Actuator
24. Reducer
25. Fuel Pump
26. Nipple
27. Bleed Valve Actuator Electrical Connector
28. Self-locking nut
29. Condensation Trap
30. Jam Nut



JT15D-5R Only

C108813

Removal/Installation - HMU
Figure 202 (Sheet 2)

(8) Disconnect the coupling nut on the P3 air delivery tube (6) from the HMU tee fitting (5).

(9) Disconnect the coupling nut on the bypass fuel tube (1) from the HMU nipple (26).

(10) Disconnect the coupling nut on the HMU-to-oil cooler pressure fuel tube (2) from the HMU reducer (24).

(11) Remove the cotterpin (18), castellated nut (19), washer (8) and bolt (22) the attach the rod end bearing (21) to the piston fork on bleed valve actuator (23).

(12) Remove the four self-locking nuts (17) and washers (8) that attach the fuel pump (14) to the accessory gearbox.

(13) Remove the fuel pump (14), bleed valve actuator (23) and HMU (3) as an assembly. Remove and discard the gasket (16).

(14) Remove the four self-locking nuts (28) and washers (80) that attach three units together. Separate the three units.

(15) Remove the four preformed packings (15). Discard the packings

(16) Install protective caps on units not to be replaced and store separately in suitable containers.

(17) If the HMU is to be replaced, remove the reducer (24), nipple (26), tee fitting (5) with condensation trap (30), and preformed packings (15). Discard all packings.

NOTE: Unless required, do not remove condensation trap (30) from tee fitting (5).

C. Installation of HMU (JT15D-5) (Ref. Fig. 201)

(1) Install HMU, bleed valve actuator and fuel pump as follows:

NOTE: The HMU, bleed valve actuator and fuel pump should be bench-assembled then installed as one unit.

(a) Inspect HMU, bleed valve actuator and fuel pump lockwiring and seals for integrity. If seals or lockwiring are broken, return unit to an approved overhaul facility for a serviceability check and install a replacement unit.

(b) If HMU is a replacement unit, install tube connectors as follows:

1 Install new preformed packing (15) on reducer (24). Install reducer and torque 110 to 120 lb.in.

2 Install new preformed packing (15) on nipple (26). Install nipple and torque 90 to 100 lb.in.

3 Pre-SB7235 engines: install new preformed packing (15) on nipple (7). Install nipple and torque 65 to 75 lb.in. Install new preformed packing (15) on condensation trap (29) and install in HMU. Torque 35 to 40 lb.in.

4 Post-SB7235 engines: install condensation trap (30) on tee fitting (5). Torque condensation trap 65 to 75 lb.in. Install preformed packing (15) and jam nut (31) on tee fitting. Install tee fitting handtight, aligned as shown on View C. Tighten jam nut 38 to 42 lb.in.

5 Pre-SB7568: Install condensation trap (30) on tee fitting (5). Torque condensation trap 65 to 75 lb.in. Install preformed packing (15) and jam nut (31) on tee fitting. Install tee fitting handtight, aligned as shown on View C. Tighten jam nut 38 to 42 lb.in.

NOTE: For engines which have not installed the locating bracket (SB7450) for the condensation trap, make sure the tee assembly is installed at 30 ± 5 degrees down from the horizontal (8 o'clock) position.

6 Post-SB7568: Install preformed packing (15) and jam nut (31) on tee fitting. Install tee fitting handtight, aligned as shown on View C. Tighten jam nut 38 to 42 lb.in.

(c) Install four new preformed packings (15) and assemble fuel pump (14), bleed valve actuator (23) and HMU (3). Secure with four washers (10) and self-locking nuts (28). Torque nuts 65 to 75 lb.in.

NOTE: Do not install washer and self-locking nut at location F (Ref. View B).

(d) Install assembly by mounting fuel pump (14) with new gasket (16) on its pad on accessory gearbox.

(e) Secure fuel pump (14) to accessory gearbox using four plain washers (10) and self-locking nuts (17). Tighten and torque nuts 150 to 170 lb.in.

(f) Connect coupling nut on HMU-to-oil cooler pressure fuel tube (2) to HMU reducer (24). While holding reducer (24), torque tube coupling nut 340 to 375 lb.in. Lockwire tube coupling nut to HMU.

(g) Connect coupling nut on fuel bypass tube (1) to HMU nipple (26). While holding nipple, torque coupling nut 90 to 100 lb.in. Lockwire coupling nut to HMU.

(h) Connect coupling nut on P3 air delivery tube (6) to HMU nipple (7) or tee fitting (5) . While holding nipple or tee fitting, torque coupling nut 90 to 100 lb.in. and lockwire. Lockwire condensation trap (30).

(i) Check witness hole in actuating rod (20). Threading only should be visible. Check security of jam nut on rod-end bearing (21). If lockwire is missing or jam nut is loose, rig bleed valve actuator (Ref. 72-30-07).

CAUTION: IF BLEED VALVE ACTUATOR WAS REPLACED, PERFORM BLEED VALVE RIGGING PROCEDURES (REF. 72-30-07).

(j) Align rod-end bearing (21) on actuating rod (20) with piston fork on bleed valve actuator (23) and install bolt (22). Install washer (10) and castellated nut (19). Torque nut 24 to 36 lb.in. and secure with cotterpin (18).

(k) Install wiring harness electrical connectors (4) and (27) to receptacles on HMU (3) and bleed valve actuator (23). Tighten handtight plus 45 degrees. Secure bleed valve connector with lockwire.

(l) Secure bracket (11) to fuel pump stud (12) at location F (Ref. View A) with washer (1) and self-locking nut (9). Torque nut 75 to 85 lb.in.

(m) Connect airframe linkage to HMU power lever (25) (Ref. Airframe Maintenance Manual).

(n) Connect airframe fuel inlet tube to fuel pump (Ref. Airframe Maintenance Manual).

(o) If a replacement HMU was installed, refer to Para. 6..

D. Installation of HMU (JT15D-5R) (Ref. Fig. 202)

(1) Install the HMU, bleed valve actuator and fuel pump as follows:

NOTE: The HMU, bleed valve actuator and fuel pump should be bench-assembled then installed as one unit.

(a) Lubricate new preformed packings (13) and (15) with a light film of engine oil (PWC03-001).

(b) Inspect the HMU, bleed valve actuator and fuel pump lockwire and seals for integrity. If the seals or lockwire are broken, return the unit to an approved overhaul facility for a serviceability check and install a replacement unit.

(c) If the HMU is a replacement unit, install the tube connectors as follows:

1 Install a new preformed packing (15) on reducer (24). Install the reducer and torque 110 to 120 lb.in.

2 Install a new preformed packing (15) on nipple (26). Install the nipple and torque 90 to 100 lb.in.

3 Install the condensation trap (30) on tee fitting (5). Torque the condensation trap 65 to 75 lb.in. Install a preformed packing (15) and jam nut (31) on the tee fitting. Install the tee fitting handtight, aligned as shown on View C. Tighten jam nut 38 to 42 lb.in.

(d) Install four new preformed packings (15) and assemble the fuel pump (14), bleed valve actuator (23) and HMU (3). Attach with four washers (8) and self-locking nuts (28). Torque the nuts 65 to 75 lb.in.

NOTE: Do not install the washer and self-locking nut at location F (Ref. View B).

(e) Install a new gasket (16) on fuel pump (14) and install the assembly on the accessory gearbox.

(f) Attach the fuel pump (14) to the accessory gearbox with four plain washers (8) and self-locking nuts (17). Tighten and torque nuts 150 to 170 lb.in.

(g) Connect the coupling nut on the HMU-to-oil cooler pressure fuel tube (2) to the HMU reducer (24). Hold the reducer (24) and torque the tube coupling nut 340 to 375 lb.in. Lockwire the tube coupling nut to HMU.

(h) Connect the coupling nut on fuel bypass tube (1) to the HMU nipple (26). Hold the nipple and torque the coupling nut 90 to 100 lb.in. Lockwire the coupling nut to HMU.

(i) Connect the coupling nut on the P3 air delivery tube (6) to tee fitting (5) . Hold the tee fitting and torque the coupling nut 90 to 100 lb.in. Lockwire the condensation trap (30).

(j) Check the witness hole in the actuating rod (20). Threading only should be visible. Check the security of the jam nut on the rod-end bearing (21). If the lockwire is missing or the jam nut is loose, rig the bleed valve actuator (Ref. 72-30-07).

CAUTION: IF THE BLEED VALVE ACTUATOR WAS REPLACED, PERFORM THE BLEED VALVE RIGGING PROCEDURES (REF. 72-30-07).

(k) Align the rod-end bearing (21) on the actuating rod (20) with the piston fork on the bleed valve actuator (23) and install the bolt (22). Install the washer (8) and castellated nut (19). Torque the nut 24 to 36 lb.in. and secure with the cotterpin (18).

(l) Install the wiring harness electrical connectors (4) and (27) to receptacles on the HMU (3) and bleed valve actuator (23). Tighten handtight plus 45 degrees. Secure the bleed valve connector with lockwire.

(m) Install new preformed packings (13) on the tubes (11) and (14).

(n) Install the tubes (11) and (14) (Ref. 73-10-01)

(o) Secure the bracket (10) to the fuel pump stud (7) at location F (Ref. View A) with the washer (8) and self-locking nut (9). Torque the nut 75 to 85 lb.in.

(p) Connect the airframe linkage to the HMU (3) (Ref. Airframe Maintenance Manual).

(q) Connect the airframe fuel inlet tube to the fuel pump (14) (Ref. Airframe Maintenance Manual).

(r) If a replacement HMU was installed, refer to Para. 6..

6. Adjustment/Test

A. Procedure for Replacement HMU

(1) If a replacement HMU is installed, perform required ground checks (Ref. 71-00-00, ADJUSTMENT/TEST, Ground Testing).

7. Inspection/Check

A. Check of Mechanical Linkage

(1) Refer to Chapter 72-00-00, INSPECTION.

(2) Check by operating input control lever, that movement of system is free over total range without binding or sticking.

NOTE: The power lever detent loading mechanism is used for rigging purposes only and should be stowed during normal engine operation.

(3) Check for freedom of movement at the spherical bearings of rod-end connectors.

(4) Check complete system to ensure that all jam nuts and connections are lockwired and that cotterpins are installed.

B. Condensation Trap - Draining (Ref. Fig. 201 and 202)

(1) For JT15D-5 Pre-SB7235 BS636 installations:

(a) Remove condensation trap (29) and preformed packing (15) from HMU (3).

(b) Drain condensation trap.

(c) Install new preformed packing (15) on condensation trap (29) and install condensation trap in HMU (3). Tighten and torque condensation trap 35 to 40 lb.in.

(2) For JT15D-5 BS657, BS713 and Post-SB7235 installations and JT15D-5R installations:

(a) Remove condensation trap (30) from tee (5) at HMU (3).

(b) Drain condensation trap.

(c) Install condensation trap (30) on tee fitting (5) at HMU (3). Tighten and torque condensation trap 65 to 75 lb.in. and lockwire.

(3) For JT15D-5 Pre-SB7568 installations:

(a) Remove condensation trap (30) from tee (5) at HMU (3).

(b) Drain condensation trap.

(c) Install condensation trap (30) on tee fitting (5) at HMU (3). Tighten and torque condensation trap 65 to 75 lb.in. and lockwire.

ENGINE ELECTRONIC CONTROL - DESCRIPTION AND OPERATION

1. Engine Electronic Control (Ref. Figs. 1, 2 and 3)

A. Description

The engine electronic control (EEC) is a limited authority control working in conjunction with the hydromechanical metering unit (HMU) to schedule fuel flow to the engine.

The EEC is a microprocessor-controlled unit which executes a program containing instructions to acquire and convert data into digital words, evaluate the data and compute to control the engine within certain specified parameters.

The EEC is fin-backed for cooling, contains four mounting parts with vibration isolators and is mounted on an engine-supplied bracket bolted to the top of the LP compressor and intermediate cases.

The interface medium for input/output signals between the EEC, engine components and the aircraft cockpit is the engine electrical wiring harness (Ref. Chapter 73-20-04).

B. EEC Analog Inputs

Analog inputs are received from the following:

(a) Power lever angle (via potentiometer in HMU)

(b) Ambient air temperature sensor (To)

(c) Ambient air pressure sensor (Po)

(d) Differential between ambient air pressure and total air pressure (ΔP)

C. EEC Frequency Inputs

Frequency inputs derived from speed sensors supply LP and HP compressor rotor speed (N1 and N2) data to the EEC.

D. Other EEC Inputs

Other discrete (controlled) inputs provide:

(a) N1 engine trim

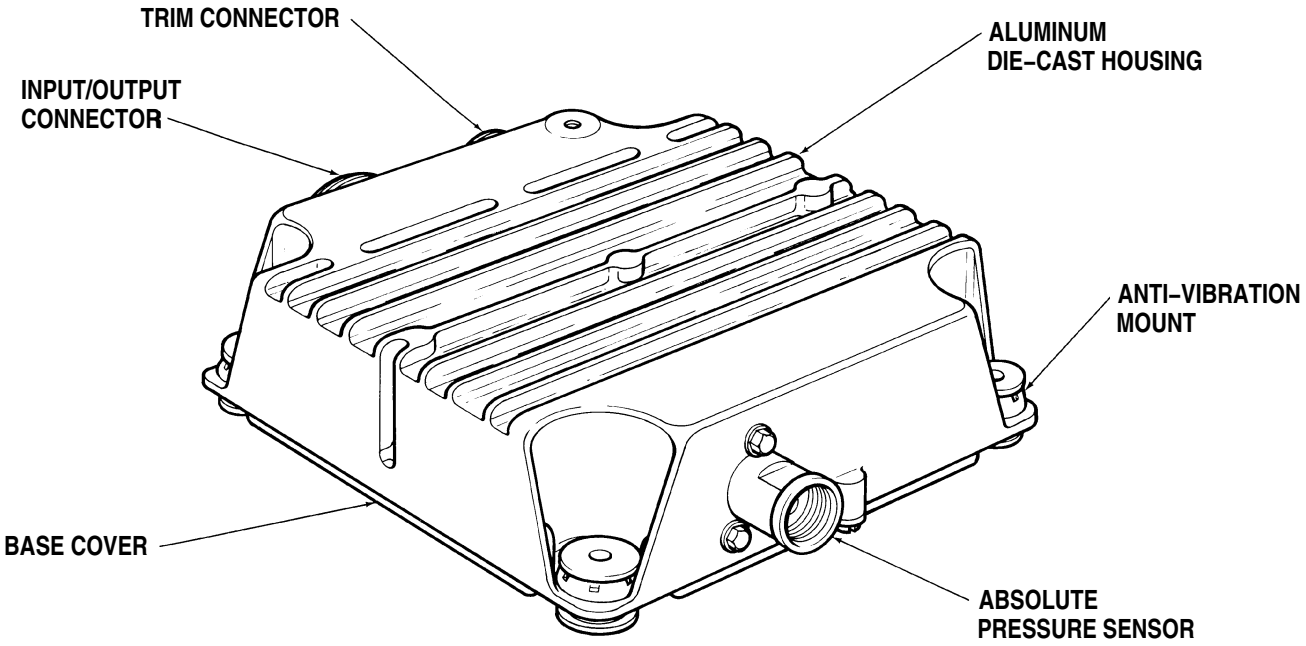
(b) A reversion feature should it be necessary to remove the ECU from control.

(c) An anti-icing input from the solenoid-operated anti-icing valve to inform the EEC of additional P3 (compressor delivery air) loads.

(d) An N2 overspeed test function.

E. EEC Outputs

Once the processor has converted all input data into digital form, it will perform the necessary computations, then output appropriate control and/or fault signals to the output circuitry.



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Engine Electronic Control (EEC) - Construction
Figure 1

The EEC outputs are the following:

(a) Output to fuel flow (Wf) torque motor located in the HMU. Changes in the torque motor input current alter the HMU fuel flow schedule.

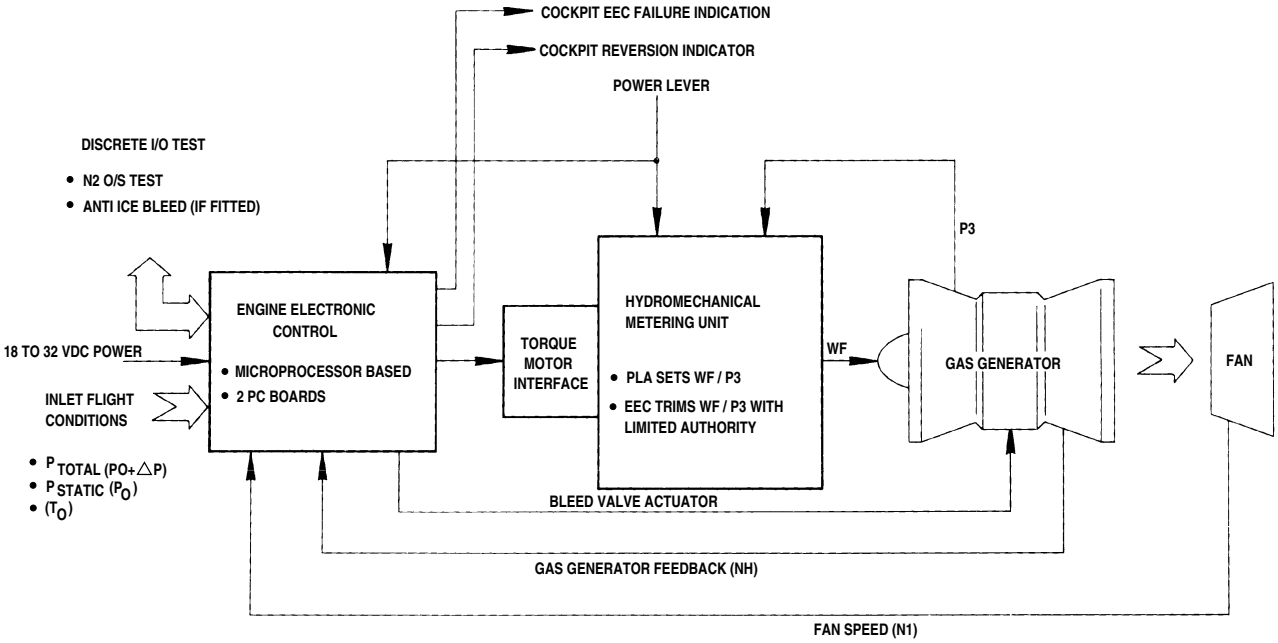
(b) Output to EEC Fault - a discrete output to inform the pilot that the EEC has sensed a fault within itself.

(c) Output to Reversion Lamp - a discrete output to inform the pilot that the EEC is no longer controlling the HMU torque motor.

(d) A number of test mode discrete outputs for trim and fault isolation.

F. Operation (Ref. Figure 2)

The HMU is solely responsible for engine fuel flow during the starting mode. Once started, the EEC assumes responsibility for all engine operating modes of acceleration, deceleration, speed governing and limiting. The EEC, however, will only control above the HMU minimum fuel flow for a specific power lever angle (PLA) position.



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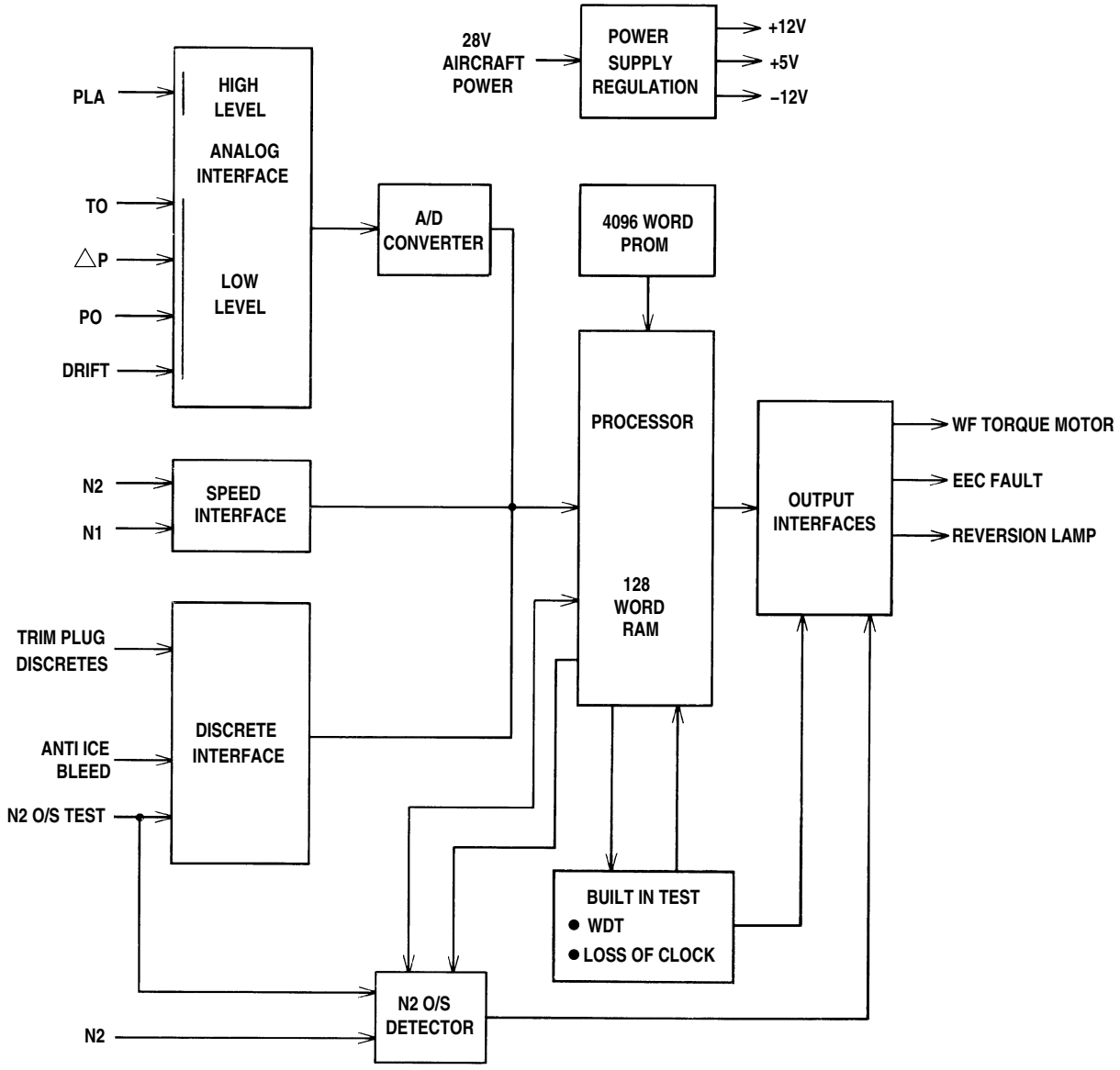
Control Block Diagram
Figure 2



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Engine Electronic Control (EEC) - Schematic
Figure 3

ENGINE ELECTRONIC CONTROL - FAULT ISOLATION

1. Fault Isolation

   Refer to 72-00-00, FAULT ISOLATION, Tables 101, 102 and 103.

ENGINE ELECTRONIC CONTROL - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the engine electronic control.

2. Consumable Materials

   Not Applicable

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal of Engine Electronic Control (Ref. Fig. 201)

      CAUTION: BEFORE BREAKING ANY ELECTRICAL CONNECTIONS, ENSURE ELECTRICAL POWER SUPPLY IS OFF. REFER TO AIRFRAME MAINTENANCE MANUAL.

      (1) Disconnect connector (1) on engine electrical wiring harness at EEC (4).

      (2) For engines installed on right-hand side of aircraft:

         (a) Remove four bolts (3) securing EEC (4) to mounting bracket (12). Position bracket (5), loop clamp (6) ground strap (14) and To temperature sensor harness (8) clear of EEC.

      (3) For engines installed on left-hand side of aircraft:

         (a) Remove four bolts (3) and two washers (9) securing EEC (4) to mounting bracket (12). Position bracket (12), two loop clamps (11) and To temperature sensor harness (8) clear of EEC.

      (4) For JT15-5 engines: Remove lockwire and unscrew Pre-SB7461 trim plug (13) or Post-SB7461cap from EEC.

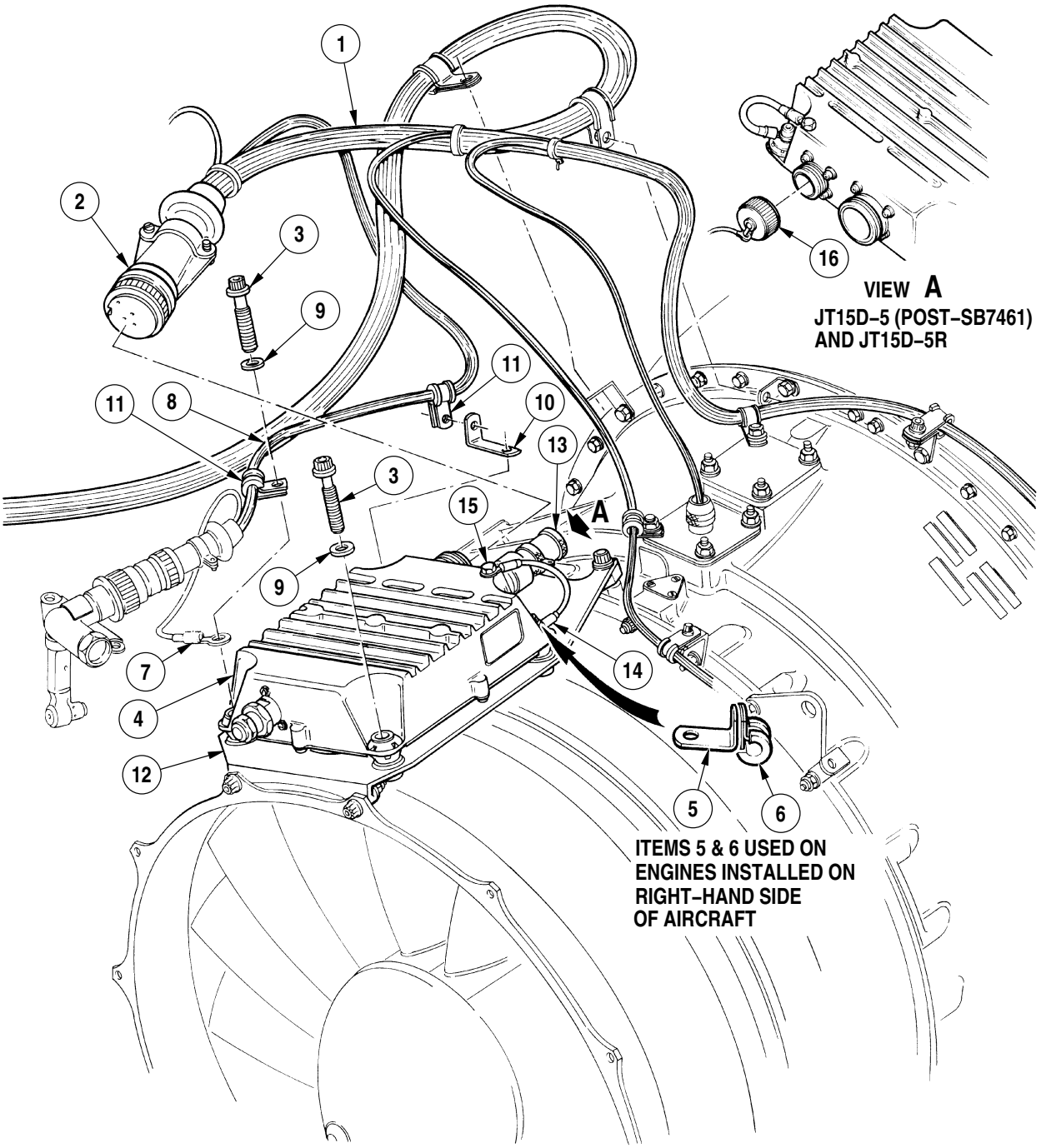
         NOTE: Trim plug must be retained with engine.

      (5) For JT15-5R engines: Remove lockwire and unscrew cap from EEC.

      (6) Carefully remove EEC (4) from mounting bracket (12) with ground strap (14).

   B. Installation of Engine Electronic Control (Ref. Fig. 201)

      (1) Position EEC (3) on engine mounting bracket (10).



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Removal/Installation - Engine Electronic Control
Figure 201

Key to Figure 201

1. Engine Electrical Wiring Harness
2. Engine Wiring Harness EEC Connector
3. Bolt
4. EEC
5. Angle Bracket
6. Loop Clamp
7. To Harness Ground Strap
8. To Harness
9. Washer
10. Angle Bracket
11. Loop Clamp
12. EEC Mount Bracket
13. Trim Plug, JT15D-5 (Pre-SB7461)
14. Ground Strap
15. Cap, JT15D-5 (Post-SB7461) and JT15D-5R

(2) For engines installed on right-hand side of aircraft: position bracket (5) with loop clamp (6) and ground strap (14) on EEC mount bosses. Install and torque four bolts (3) bolts 20 to 30 lb.in.

(3) For engines installed on left-hand side of aircraft: position bracket (10) two loop clamps (11) and To sensor harness ground strap (7) on EEC mount bosses. Install two washers (9) and four bolts (3). Torque bolts 24 to 36 lb.in.

(4) For JT15D-5 (Pre-SB7461) engines: connect trim plug (13) to EEC (4). Tighten plug fingertight plus 45 ° and secure with lockwire.

(5) For JT15D-5 (Post-SB7461) and JT15D-5R engines: Install cap (15) on EEC connector. Tighten plug fingertight plus 45°.

(6) Install engine wiring harness EEC connector (1) on EEC (3). Tighten fingertight plus 45° .

6. Functional Check

After replacement of engine electronic control, carry out engine ground running check (Ref. 71-00-00, ADJUSTMENT/TEST, Ground Testing).

7. Inspection/Check

Check connectors and ground straps for general condition. Check vibration insulators for hardening or cracks and housing for impact damage. Check base cover plate for distortion (Ref. Fig. 201) .

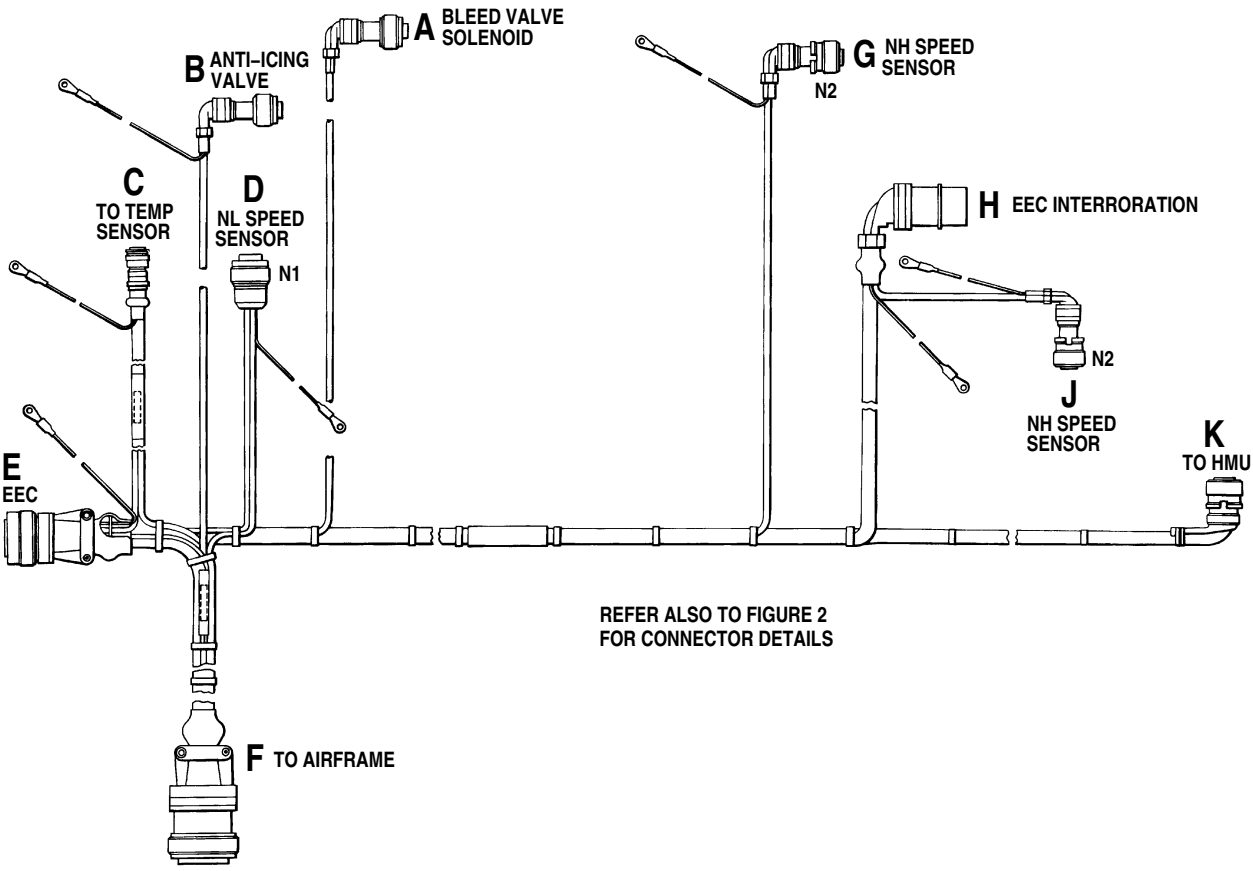
ENGINE WIRING HARNESS - DESCRIPTION AND OPERATION

1. Engine Electrical Wiring Harness (Ref. Figs. 1 and 3)

The engine electrical wiring harness consists of a complex cable assembly, suitably insulated, shielded and equipped with quick disconnects at each terminal point.

The various cable assemblies are spliced in at manufacture, forming an integral wiring assembly. The harness is suitably clamped and supported around the engine left-hand side for engines installed on right side of aircraft, or engine right-hand side for engines installed on left side of aircraft.

The wiring harness transmits electrical power from the airframe 28 volt d.c. supply to the engine electronic control (EEC), engine anti-icing valve, bleed valve solenoid . It transmits engine compressor rotor speed signals to and from the EEC, and carries EEC failure indications to the airframe. The harness electrically interconnects the EEC and hydromechanical metering unit (HMU) and also interconnects the airframe with the N1 and N2 speed sensors, To sensor and interrogator.



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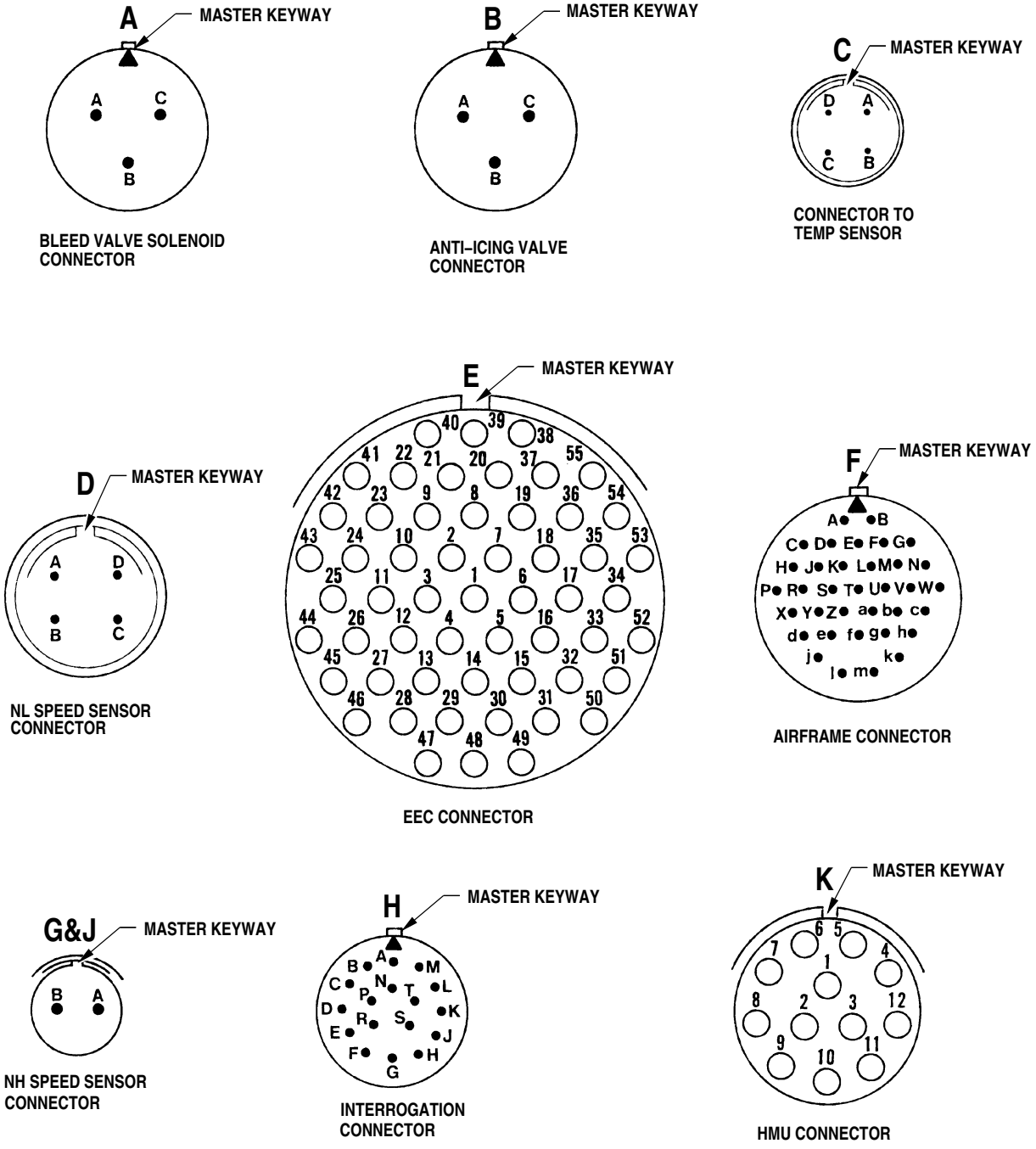
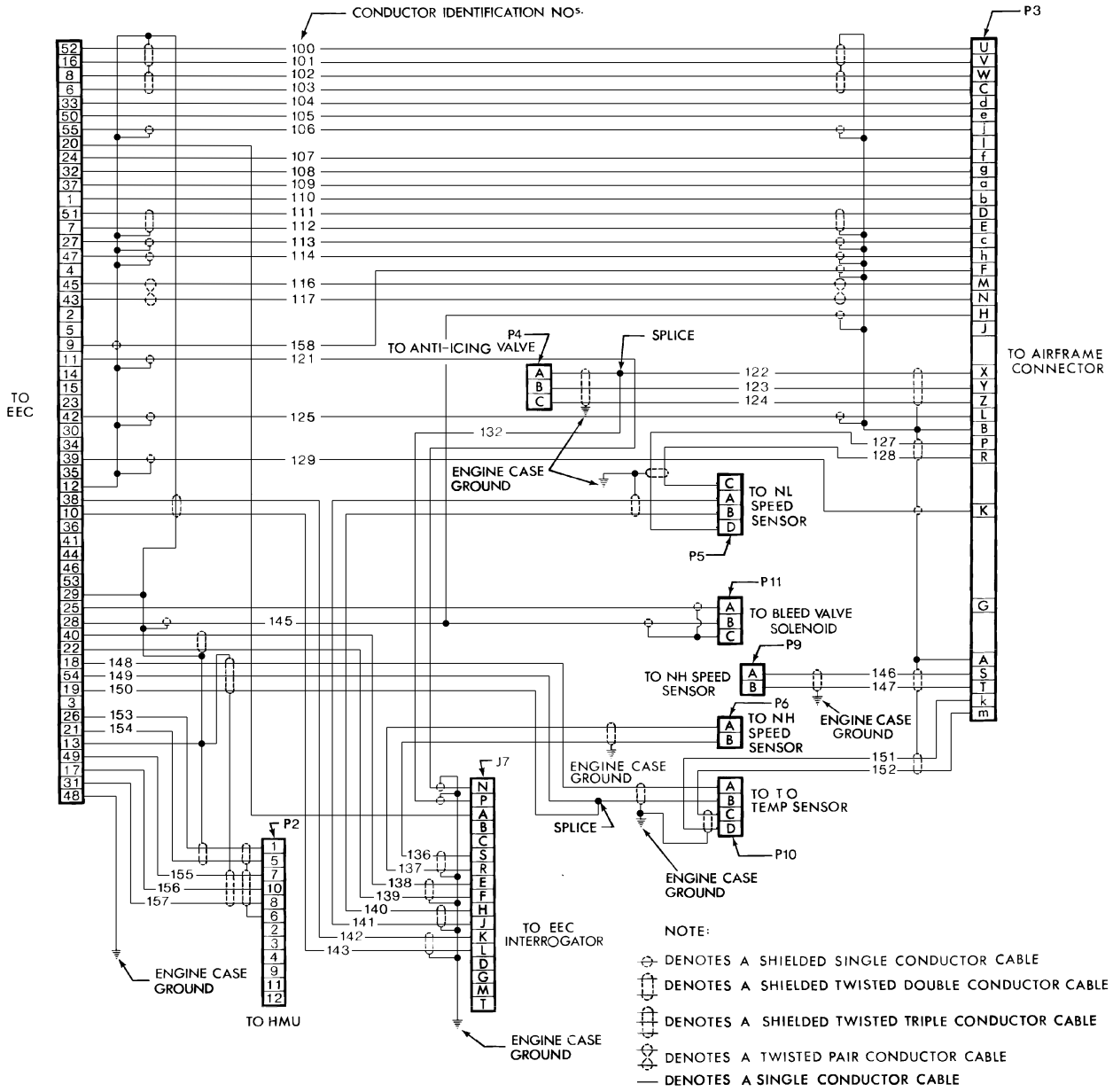
Engine Electrical Wiring Harness (Schematic)
Figure 1


A
MASTER KEYWAY
A
C
B
BLEED VALVE SOLENOID CONNECTOR
B
MASTER KEYWAY
A
C
B
ANTI–ICING VALVE CONNECTOR
C
MASTER KEYWAY
D
A
C
B
CONNECTOR TO TEMP SENSOR
D
MASTER KEYWAY
A
D
B
C
NL SPEED SENSOR CONNECTOR
E
MASTER KEYWAY
40 39 38 41 22 21 20 37 55 42 23 9 8 19 36 54 43 24 10 2 7 18 35 53 25 11 3 1 6 17 34 44 26 12 4 5 16 33 52 45 27 13 14 15 32 51 46 28 29 30 31 50 47 48 49
EEC CONNECTOR
F
MASTER KEYWAY
A B C D E F G H J K L M N P R S T U V W X Y Z a b c d e f g h j k l m
AIRFRAME CONNECTOR
G&J
MASTER KEYWAY
B
A
NH SPEED SENSOR CONNECTOR
H
MASTER KEYWAY
A B C D E F G H J K L M N P R S T
INTERROGATION CONNECTOR
K
MASTER KEYWAY
6 5 7 1 4 8 2 3 12 9 10 11
HMU CONNECTOR

C11550A

Engine Electrical Wiring Harness - Connectors
Figure 2



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Engine Electrical Wiring Harness - Electrical Layout
Figure 3

ENGINE ELECTRICAL WIRING HARNESS - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance procedures for the engine electrical wiring harness.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC05-256	Electrical Contact Enhancer
PWC11-023	Cleaning Solvent
PWC11-035	Cleaning Solvent, Electrical Contacts
PWC11-036	Electrical Deoxidizer Solvent

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal of Engine Wiring Harness (Ref. Figs. 201, 202, 203 and 204)

   CAUTION: ENSURE ELECTRICAL POWER SUPPLY IS OFF (REFER TO AIRFRAME MAINTENANCE MANUAL).

   NOTE: As each harness connector is disconnected, suitably protect exposed unit orifices on engine and each harness connector.

   (1) Disconnect the engine wiring harness P3 connector from mating airframe receptacle (Ref. Airframe Maintenance Manual).

   (2) **Removal from Left Side of Engine (Ref. Fig. 203):**

   (a) Refer to Detail E: disconnect the engine HMU P2 electrical connector (22).

   (b) JT15D-5 (Post-SB7305, Post-SB7597) and JT15D-5R: loosen and remove one bolt (11) and one nut (13) securing the harness cable loop clamp to bracket on the HMU/fuel pump/BVA assembly.

   (c) Refer to Detail F:

   1 Loosen and remove two bolts (17) securing the grounding cables (19).

   2 Disconnect and remove the engine wiring harness engine P6 and P9 N2 speed sensor electrical connectors (18) and (20).

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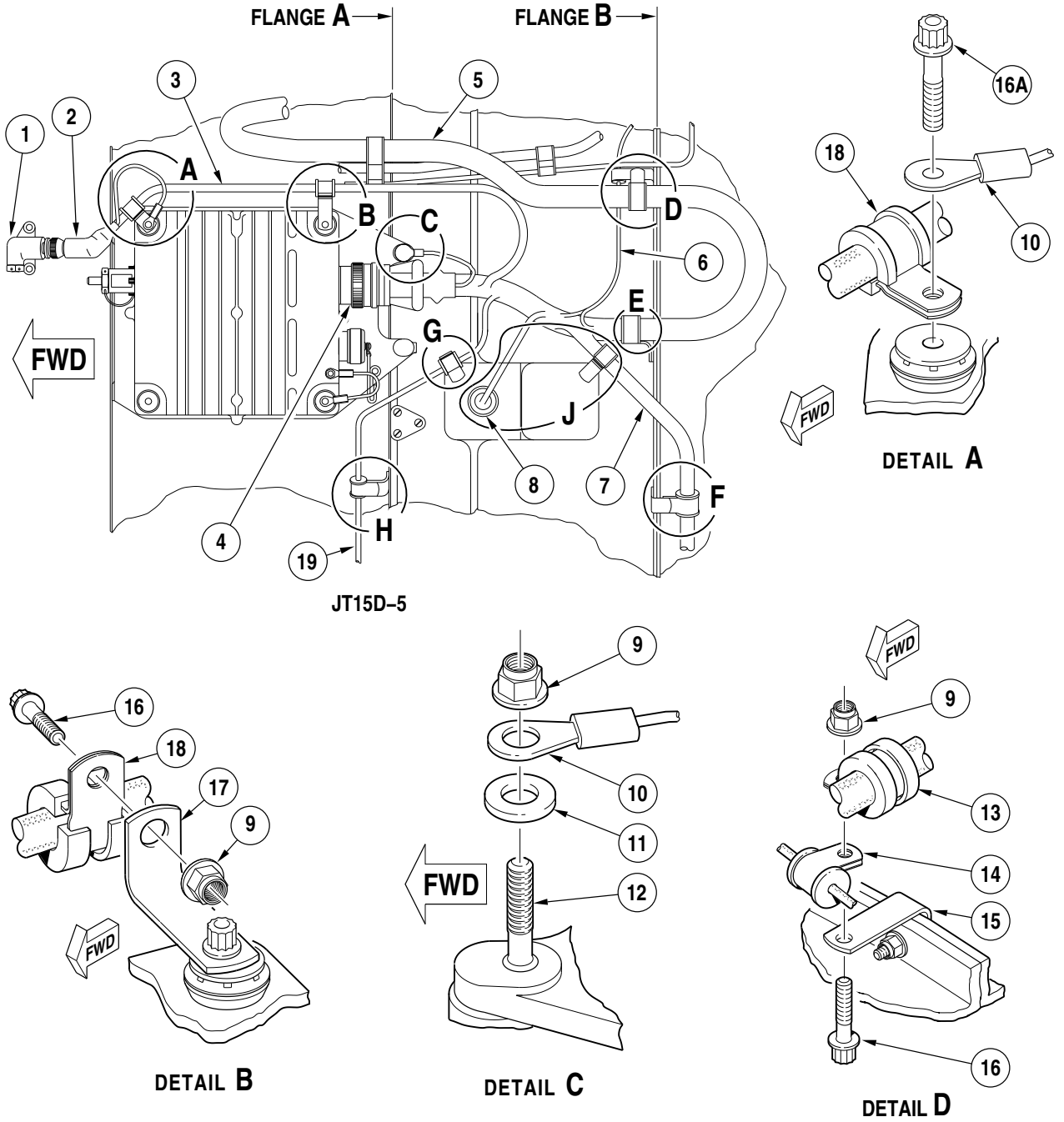

LEFT ENGINE TOP VIEW (JT15D-5) C178352

Removal/Installation - Engine Wiring Harness: Left Engine Top
Figure 201 (Sheet 1 of 4)

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Key to Figure 201

1. To/Po Sensor
2. Engine Wiring Harness To/Po Sensor Connector
3. Engine Wiring Harness To/Po Sensor Cable
4. Engine Wiring Harness EEC Connector
5. Engine Wiring Harness Aircraft Connector Cable
6. Engine Wiring Harness Bleed Valve Actuator Cable
7. Engine Wiring Harness HMU/Speed Sensor Cable
8. Engine Wiring Harness N1 Speed Sensor Connector
9. Self-locking Nut
10. Grounding Cable
11. Washer
12. Stud
13. Loop Clamp Assembly
14. Loop Clamp Assembly
15. Angle Bracket
16. Bolt

16A. Bolt

17. Bracket
18. Loop Clamp Assembly
19. Engine Wiring Harness Anti-icing Valve Cable
20. Loop Clamp Assembly
21. Loop Clamp Assembly
22. Loop Clamp Assembly (Post-SB7622)

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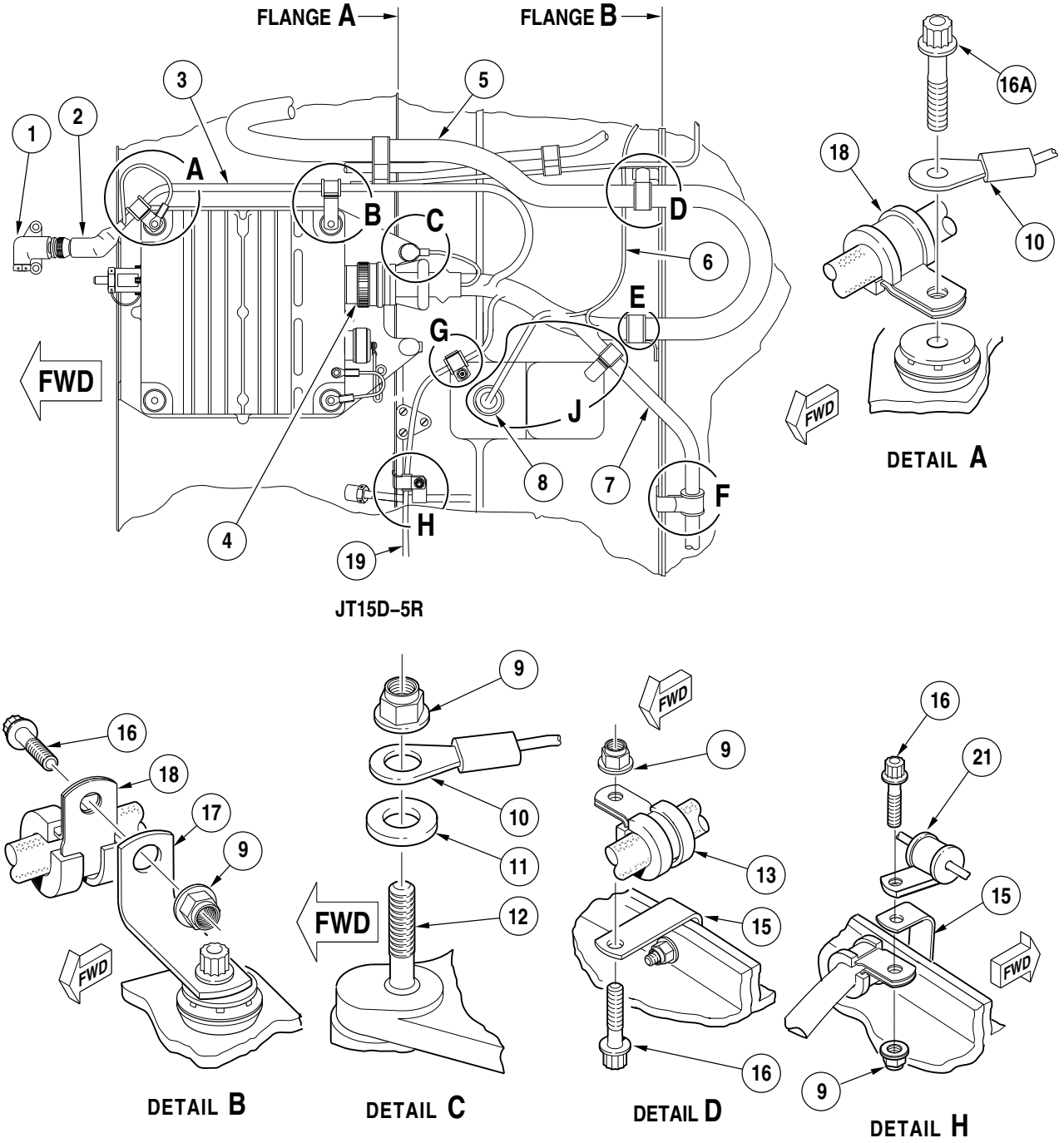

LEFT ENGINE TOP VIEW (JT15D-5R) C178353

Removal/Installation - Engine Wiring Harness: Left Engine Top
Figure 201 (Sheet 2)

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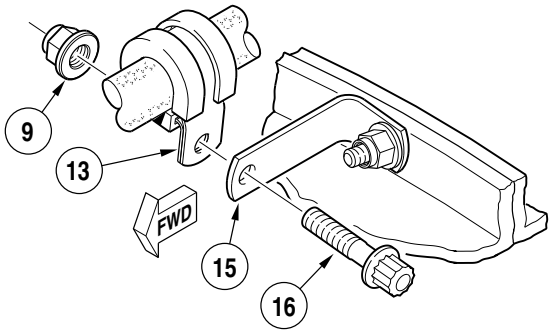
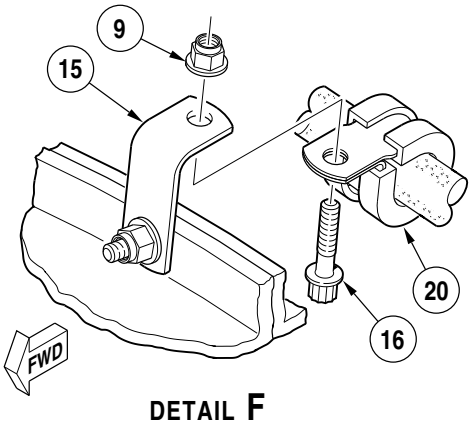
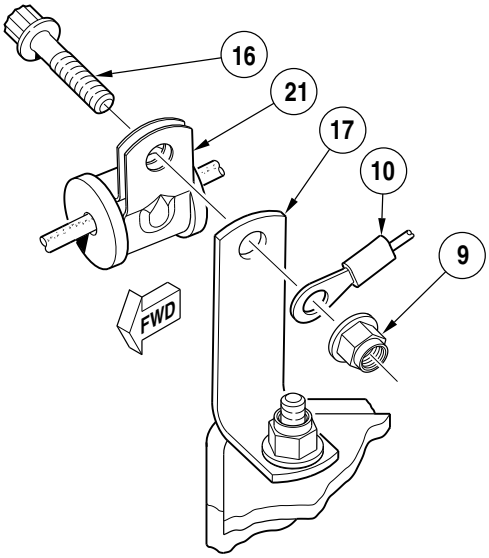


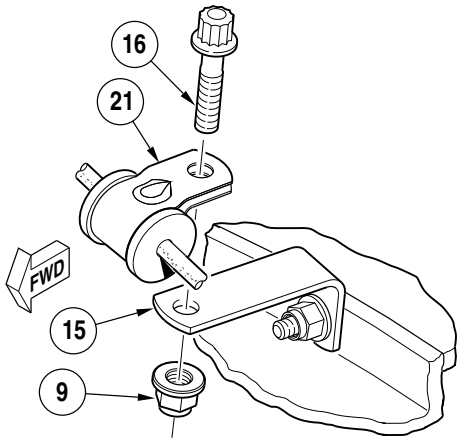
DETAIL **E**



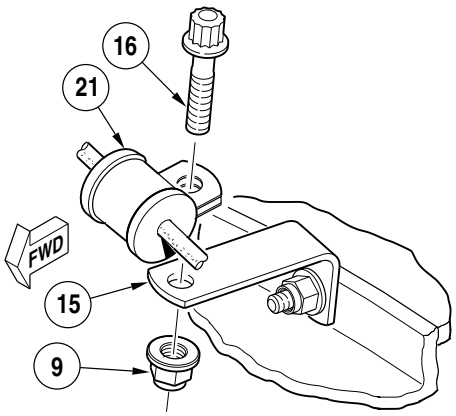
DETAIL **F**



DETAIL **G**



DETAIL **H**
ONLY FOR JT15D–5 (PRE–SB7597)



DETAIL **H**
ONLY FOR JT15D–5 (POST–SB7597)

LEFT ENGINE TOP VIEW (JT15D-5 AND JT15D-5R) C178354

Removal/Installation - Engine Wiring Harness: Left Engine Top
Figure 201 (Sheet 3)

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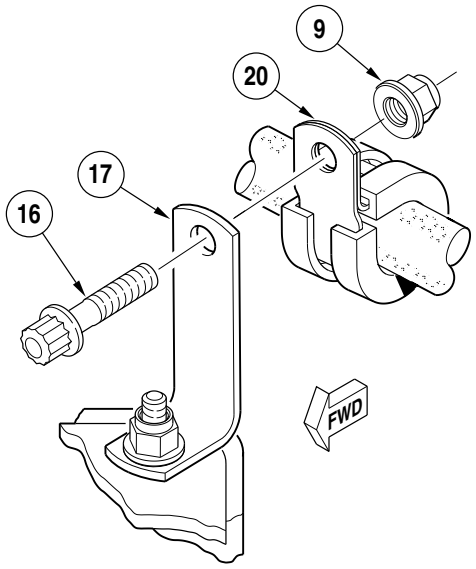
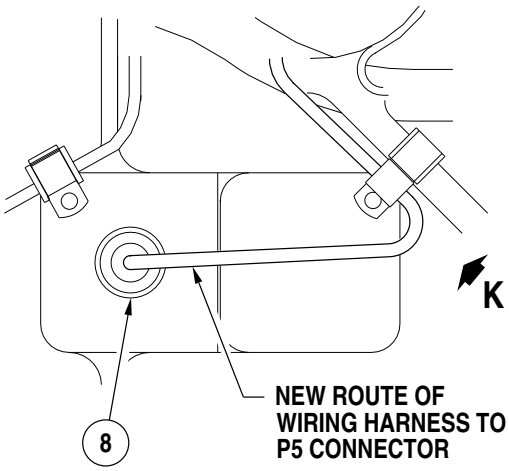
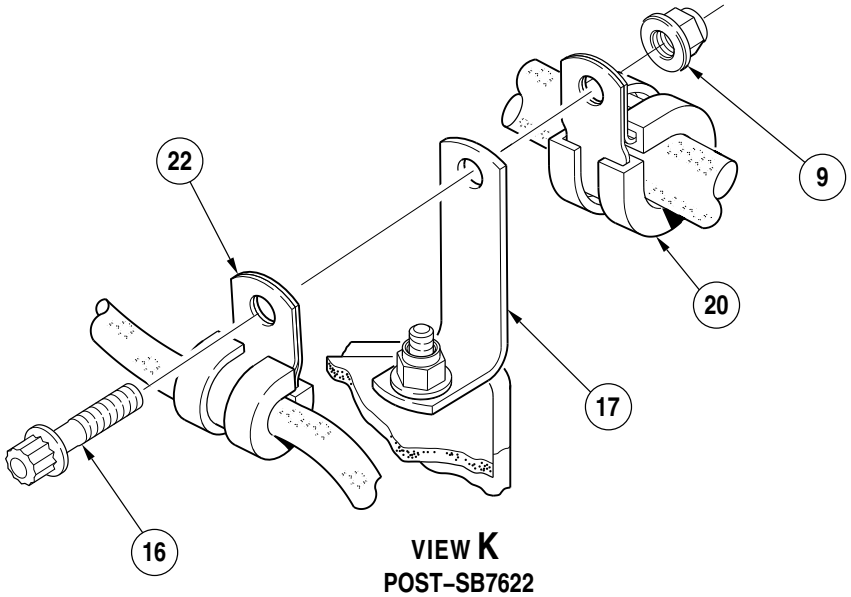


DETAIL J
PRE–SB7622



DETAIL J
POST–SB7622



VIEW K
POST–SB7622

LEFT ENGINE TOP VIEW (JT15D-5 AND JT15D-5R) C178359

Removal/Installation - Engine Wiring Harness: Left Engine Top
Figure 201 (Sheet 4)

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(d) Refer to Detail D:

1 Remove one bolt (10) and nut (5) securing grounding cables (6) and (9).

2 Disconnect and remove the engine wiring harness engine J7 EEC interrogator electrical connector (7).

3 Remove four bolts (2) and nuts (8) securing connector (3) to bracket (4).

(e) Refer to Details C and B: remove seven bolts (11) and nuts (13) securing loop clamp assemblies (12), (12A) to Flange B angle brackets (14).

(f) Refer to Detail A: remove bolt (11) and nut (13) securing loop clamp (16) and grounding cable (9) to bracket (15).

(g) For JT15D-5R, refer to Detail G: remove bolt (11) and nut (13), securing loop clamp (16) to bracket (15).

(h) Disconnect the engine wiring harness engine P4 anti-icing valve electrical connector (1).

(3) **Removal from Right Side of Engine (Ref. Fig. 204):**

(a) Disconnect the engine wiring harness bleed valve actuator P11 connector (8).

(b) Refer to Detail D: loosen and remove one bolt (7) and nut (1) securing engine wiring harness loop clamps (14), (15) and (16).

(c) For JT15D-5 engines, refer to Detail E: loosen and remove three bolts (7) and nuts (1) securing engine wiring harness loop clamps (13) and (14) to three Flange B angle brackets (12).

(d) For JT15D-5R engines, refer to Detail E: loosen and remove bolt (7) and nut (1) securing engine wiring harness loop clamps (13) and (17) to Flange B angle bracket (12).

(e) For JT15D-5 engines, refer to Detail F: loosen and remove two bolts (7) and nuts (1) securing engine wiring harness loop clamps (13), (14) and (17) to two Flange B angle brackets (12).

(f) JT15D-5 (Pre-SB7597): refer to Detail C. Loosen and remove bolt (7) and nut (1).

(g) Refer to Detail B: loosen and remove bolt (7), nut (1) and spacer (3).

(4) **Removal from Top of a Left Engine (Ref. Fig. 201):**

(a) Disconnect the engine wiring harness To temperature sensor P10 electrical connector (2) from the To sensor (1).

(b) Disconnect the engine wiring harness engine P5 N1 speed sensor electrical connector (8).

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(c) Refer to Detail A: remove one bolt (16A) securing harness loop clamp and grounding cable to the EEC mounting location.

(d) Refer to Details B and C: remove two nuts (9), one washer (11) and one bolts (16) securing harness loop clamp (18) and grounding cable (10).

(e) For JT15D-5 engines, refer to Detail D: remove one nut (9) and one bolt (16) securing harness loop clamp (13) and (14) to bracket (15).

(f) For JT15D-5R engines, refer to Detail D: remove one nut (9) and one bolt (16) securing harness loop clamp (13) to bracket (15).

(g) Refer to Details E, F, G, H and J: remove five nuts (9) and five bolts (16) securing harness loop clamps and grounding cables.

(h) Disconnect the engine wiring harness engine P1 EEC electrical connector (4). Carefully remove engine wiring harness with loop clamps and fasteners from the engine. Place harness in a suitable protective container.

(5) **Removal from Top of a Right Engine (Ref. Fig. 202):**

(a) Disconnect the engine wiring harness To temperature sensor P10 electrical connector (4) from the To sensor (5).

(b) Disconnect the engine wiring harness engine P5 N1 speed sensor electrical connector (9).

(c) Refer to Details A, B, and C: remove three nuts (1) and three bolts (7) securing harness loop clamps.

(d) Refer to Details E, F, G, H, J, K and L: remove seven nuts (1), one washer (20) and six bolts (7) securing harness loop clamps and grounding cables.

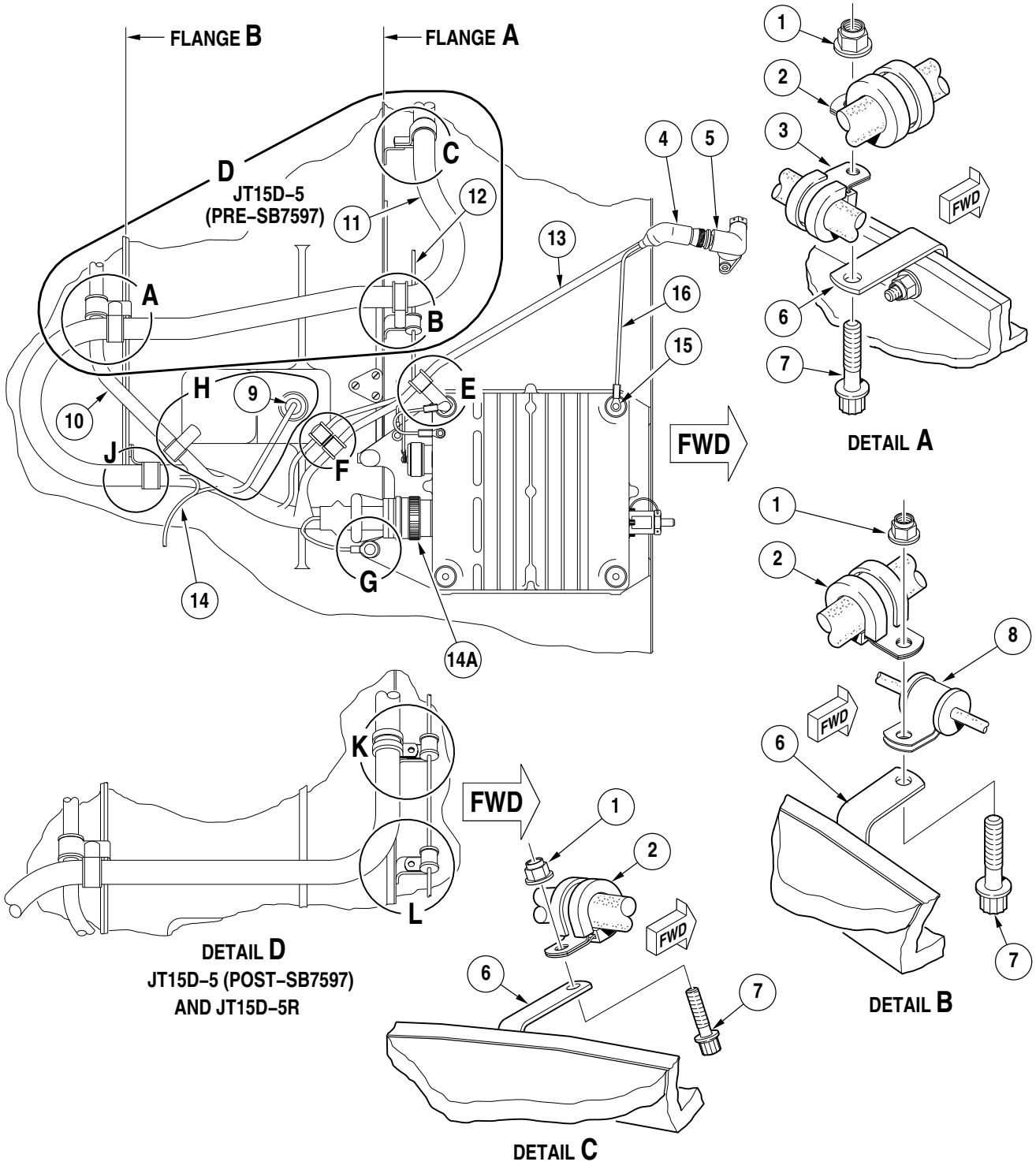
(e) Disconnect the engine wiring harness engine P1 EEC electrical connector (14A). Carefully remove engine wiring harness with loop clamps and fasteners from the engine. Place harness in a suitable protective container.

B. Installation of Engine Wiring Harness (Ref. Figs. 201, 202, 203 and 204)

CAUTION: ENSURE ELECTRICAL POWER SUPPLY IS OFF (REF. AIRFRAME MAINTENANCE MANUAL).

NOTE: Unless otherwise stated, the following procedures are common for an engine installed on the right or left side of the aircraft.

(1) Position wiring harness assembly around the engine, and align the electrical connectors with their respective mating units and connectors.



RIGHT ENGINE TOP VIEW (JT15D-5) C178355

Removal/Installation - Engine Wiring Harness: Right Engine Top
Figure 202 (Sheet 1 of 4)

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Key to Figure 202

1. Self-locking Nut
2. Loop Clamp Assembly
3. Loop Clamp Assembly
4. Engine Wiring Harness To/Po Sensor Connector
5. To/Po Sensor
6. Angle Bracket
7. Bolt
8. Loop Clamp Assembly
9. Engine Wiring Harness N1 Speed Sensor Connector
10. Engine Wiring Harness HMU/Speed Sensor Cable
11. Engine Wiring Harness Aircraft Connector Cable
12. Engine Wiring Harness Anti-icing Valve Cable
13. Engine Wiring Harness To/Po Sensor Cable
14. Engine Wiring Harness Bleed Valve Actuator Cable

14A. Engine Wiring Harness EEC Connector

15. Bolt
16. Grounding Cable
17. Loop Clamp Assembly
18. Angle Bracket
19. Grounding Cable
20. Washer
21. Stud
22. Angle Bracket
23. Loop Clamp Assembly
24. Loop Clamp Assembly
25. Loop Clamp Assembly (Post-SB7622)

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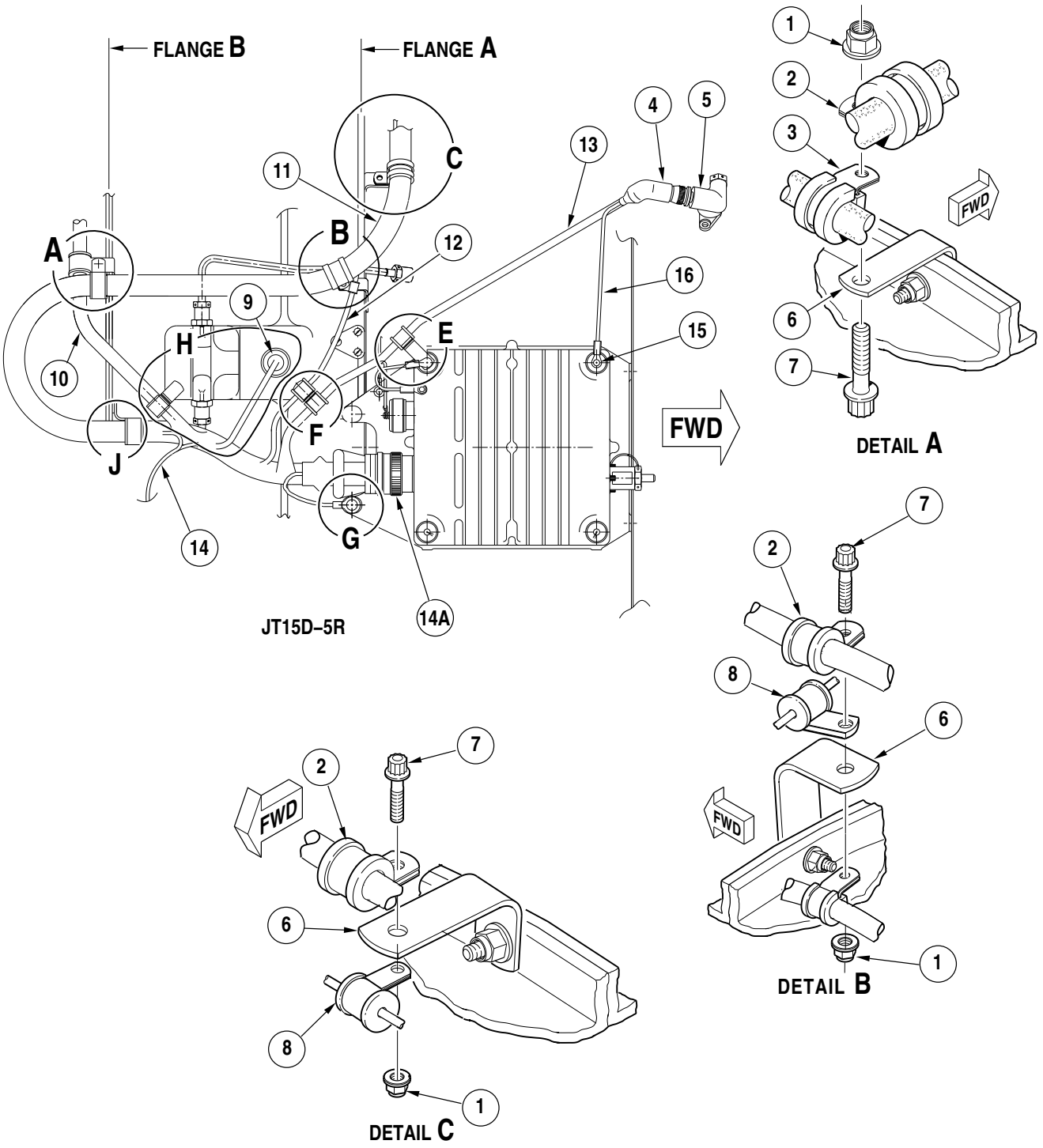

RIGHT ENGINE TOP VIEW (JT15D-5R) C178356

Removal/Installation - Engine Wiring Harness: Right Engine Top
Figure 202 (Sheet 2)

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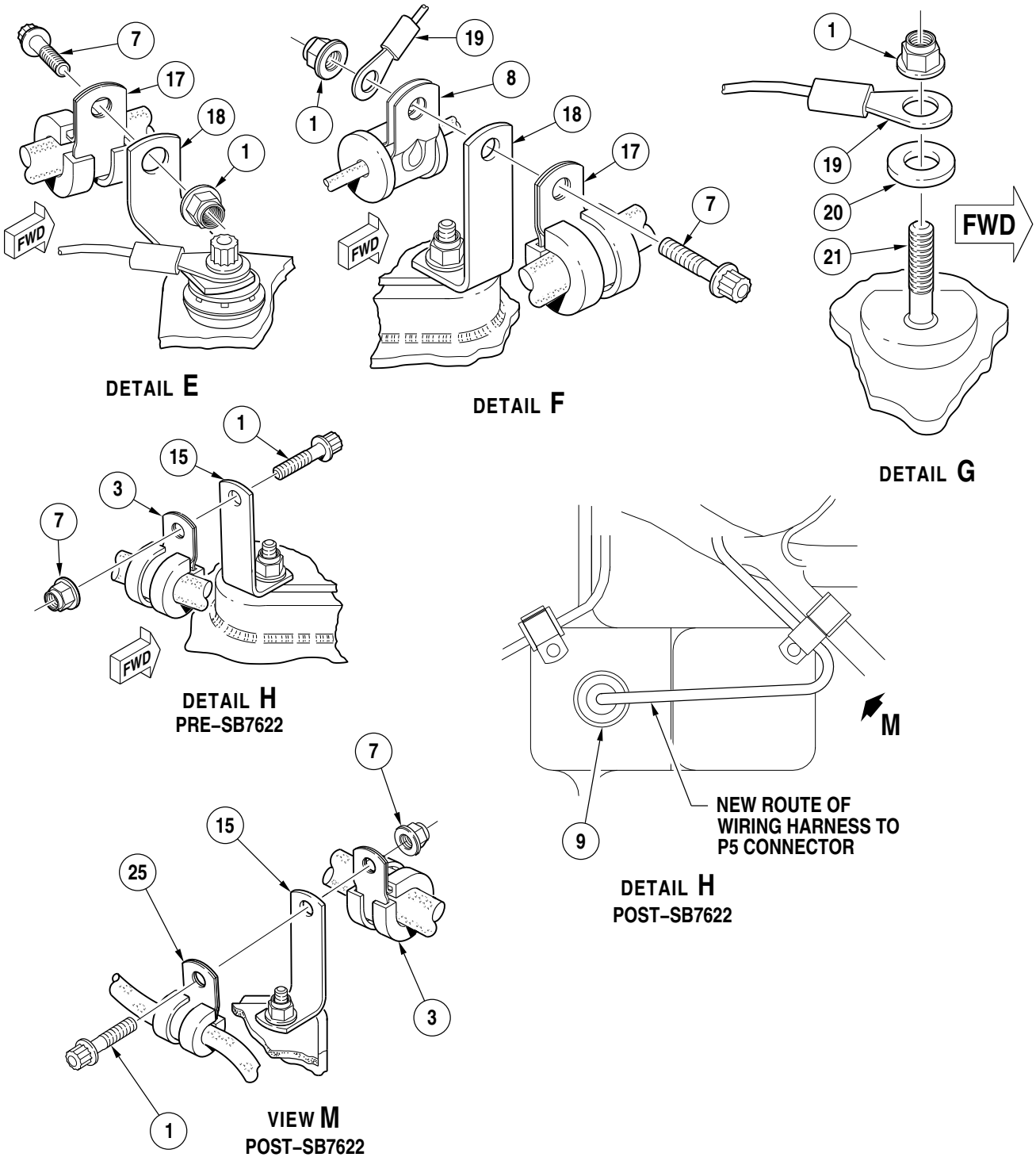

RIGHT ENGINE TOP VIEW (JT15D-5 AND JT15D-5R) C178357

Removal/Installation - Engine Wiring Harness: Right Engine Top
Figure 202 (Sheet 3)

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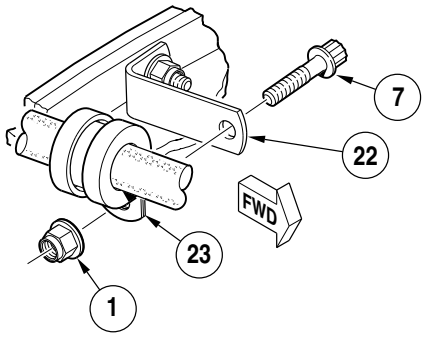
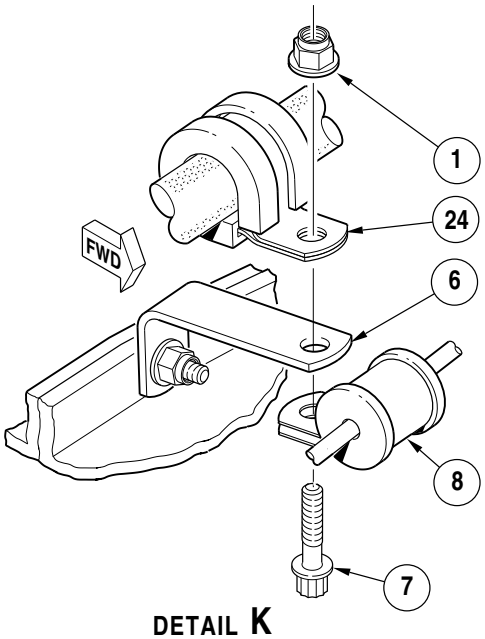
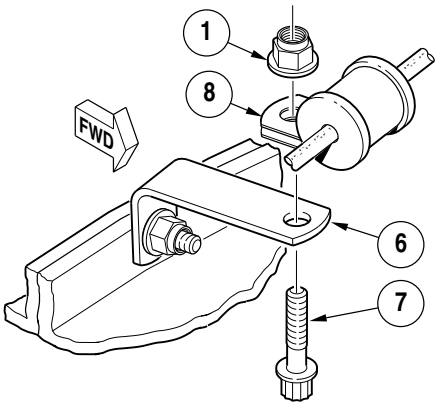


DETAIL J



DETAIL K



DETAIL L
(ONLY FOR JT15D–5)

RIGHT ENGINE TOP VIEW (JT15D-5 AND JT15D-5R) C178360

Removal/Installation - Engine Wiring Harness: Right Engine Top
Figure 202 (Sheet 4)

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J7	Engine EEC Interrogator Electrical Connector
P1	Engine EEC Electrical Connector
P2	Engine HMU Electrical Connector
P3	Engine Aircraft Harness ElectricalConnector
P4	Engine Anti-icing Valve Electrical Connector
P5	N1 Speed Sensor Electrical Connector
P6	N2 Speed Sensor Electrical Connector
P9	N2 Speed Sensor Electrical Connector
P10	To Temperature Sensor Electrical Connector
P11	Engine Bleed Valve Actuator Electrical Connector

(2) Apply electrical contact enhancer (PWC05-256) onto all engine wiring harness electrical connectors before installing them.

(3) Make sure all protective covers are removed from harness connectors and unit receptacles before installation.

(4) **Installation of Harness on Top of a Left Engine (Ref. Fig. 201):**

NOTE: The orientation of some loop clamps is different between JT15D-5 (Pre-SB7597) and JT15D-5 (Post-SB7597) engines. Refer to details on Figure 201.

(a) Connect the engine wiring harness P1 connector (4) to mating connector on the EEC. Tighten the connector fingertight plus 45 degrees.

(b) Refer to Detail C: secure the main harness connector grounding cable (10) to stud (12) on the EEC mounting bracket with washer (11) and nut (9). Tighten and torque the nut to 32 to 36 lb.in. Apply lockwire to secure the electrical connector (4).

(c) Secure engine wiring harness P5 connector (8) to the N1 speed sensor. Tighten the connector fingertight plus 45 degrees. Apply lockwire to secure the connector.

(d) Refer to Detail J:

NOTE: Install bolt with the bolt head forward.

1 Pre-SB7622: Attach loop clamp (20) on wiring harness N2 sensor/HMU connector cable (7) to angle bracket (17) on the borescope access pad with bolt (16) and nut (9). Torque the nut to 36 to 40 lb.in.

2 Post-SB7622: Attach loop clamp (20) on wiring harness N2 sensor/HMU connector cable (7) and loop clamp (22) on wiring harness N1 speed sensor connector cable (8) to angle bracket (17) on the borescope access pad with bolt (16) and nut (9). Torque the nut to 36 to 40 lb.in.

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(e) Refer to Detail F: secure loop clamp (20) on wiring harness N2 sensor/HMU connector cable (7) to Flange B angle bracket (15) with bolt (16) and nut (9). Tighten and torque the nut to 36 to 40 lb.in.

(f) For JT15D-5 engines, refer to Details D and E: secure loop clamps (13) and (14) on cables (5) and (6) to Flange B angle brackets (15) with two bolts (16) and nuts (9). Tighten and torque the nuts to 36 to 40 lb.in.

(g) For JT15D-5R engines, refer to Details D and E: secure loop clamps (13) on cable (5) to Flange B angle brackets (15) with two bolts (16) and nuts (9). Tighten and torque the nuts to 36 to 40 lb.in.

(h) Refer to Detail B: secure loop clamp (18) on the harness To sensor cable (3) to angle bracket (17) mounted on the EEC with bolt (16) and self-locking nut (9). Tighten and torque the nut to 36 to 40 lb.in.

(i) Refer to Detail A: secure loop clamp (18) and the To sensor connector grounding cable (10) to EEC mount pad with bolt (16A). Tighten and torque the bolt to 20 to 30 lb.in.

(j) Secure the engine To sensor cable connector (2) to the To sensor (1) (Ref. Aircraft Maintenance Manual).

(k) Refer to Detail G: secure harness anti-icing cable loop clamp (21) and the harness N1 speed sensor connector grounding cable (10) to angle bracket (17) with bolt (16) and nut (9). Tighten and torque the nut to 36 to 40 lb.in.

(l) Refer to Detail H: secure the harness anti-icing solenoid cable loop clamp (21) to Flange A angle bracket (15) with bolt (16) and nut (9). Tighten and torque the nut to 36 to 40 lb.in.

(5) **Installation of Harness on Top of a Right Engine (Ref. Fig. 202):**

NOTE: The orientation of some loop clamps is different on JT15D-5 (Pre-SB7597) and (Post-SB7597 engines. Refer to details on Figure 202.

(a) Connect the engine wiring harness P1 connector (14A) to mating connector on the EEC. Tighten the connector fingertight plus 45 degrees.

(b) Refer to Detail G: secure the main harness connector grounding cable (19) to stud (21) on the EEC mounting bracket with nut (1). Tighten and torque the nut to 32 to 36 lb.in. Apply lockwire to secure the electrical connector (14).

(c) Secure engine wiring harness P5 connector (9) to the N1 speed sensor. Tighten the connector fingertight plus 45 degrees. Apply lockwire to secure the connector.

(d) Refer to Detail H:

NOTE: Install with the bolt head forward.

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1 Pre-SB7622: Attach loop clamp (3) on wiring harness N2 sensor/HMU connector cable (10) to angle bracket (15) on the borescope access pad with bolt (7) and nut (1). Torque the nut to 36 to 40 lb.in.

2 Post-SB7622: Attach loop clamp (3) on wiring harness N2 sensor/HMU connector cable (10) and loop clamp (25) on wiring harness N1 speed sensor connector cable (9) to angle bracket (17) on the borescope access pad with bolt (7) and nut (1). Torque the nut to 36 to 40 lb.in.

(e) Refer to Detail A: Secure loop clamps (2) and (3) to angle bracket (6) with bolt (7) and nut (1). Tighten and torque the nut to 36 to 40 lb.in.

(f) Refer to Detail J: secure loop clamp (23) to Flange B angle bracket (22) with bolt (7) and nut (1). Tighten and torque the nut to 36 to 40 lb.in.

(g) Refer to Detail F: secure harness anti-icing solenoid cable loop clamp (8), To sensor cable loop clamp (17) and the harness N1 speed sensor connector grounding cable (19) to angle bracket (18) with bolt (7) and nut (1). Tighten and torque the nut to 36 to 40 lb.in.

(h) Refer to Detail E: secure loop clamp (17) on the harness To sensor cable (13) to angle bracket (18) mounted on the EEC with bolt (7) and self-locking nut (1). Tighten and torque the nut to 36 to 40 lb.in.

(i) Secure the To sensor connector grounding cable (16) to EEC mounting location with bolt (15)(Ref. Sheet 1). Tighten and torque the bolt to 20 to 30 lb.in.

(j) JT15D-5 (Pre-SB7597). Refer to Detail B: secure harness aircraft connector cable loop clamp (2) and anti-icing solenoid cable loop clamp (8) to Flange A angle bracket (6) with bolt (7) and nut (1). Tighten and torque the nut to 36 to 40 lb.in.

(k) JT15D-5 (Post-SB7597) and JT15D-5R. Refer to Detail L: secure harness anti-icing cable loop clamp (8) to Flange A angle bracket (6) with bolt (7) and nut (1). Tighten and torque the nut to 36 to 40 lb.in.

(l) Refer to JT15D-5 (Pre-SB7597) Detail C or to JT15D-5 (Post-SB7597) and JT15D-5R Detail K: secure harness aircraft connector cable loop clamp (2) or (24) to Flange A angle bracket (6) with bolt (7) and nut (1). Tighten and torque the nut to 36 to 40 lb.in.

(m) Secure the harness To sensor cable connector (4) to the To sensor (5)(Ref. Aircraft Maintenance Manual).

(6) **Installation of Harness on Left Side of Engine (Ref. Fig. 203):**

(a) Connect engine wiring harness P4 connector (1) to mating connector on the anti-icing solenoid valve. Tighten the connector fingertight plus 45 degrees. Apply lockwire to secure the connector.

(b) Refer to Detail A: secure harness anti-icing solenoid cable loop clamp (16) and grounding cable (9) to Flange A angle bracket (15) with bolt (11) and nut (13). Tighten and torque the nut to 36 to 40 lb.in.

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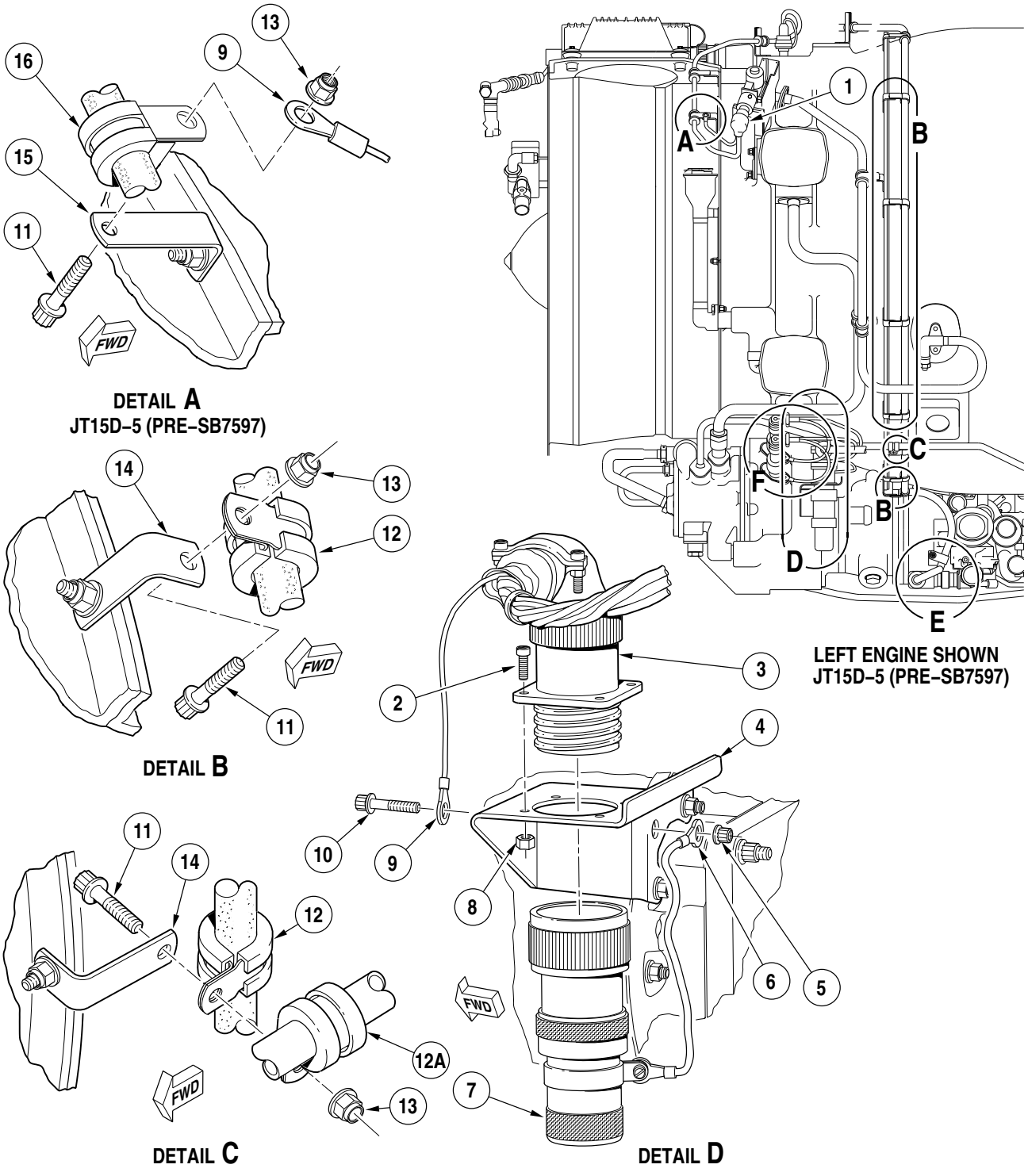

JT15D-5 AND JT15D-5R C96935C

Removal/Installation - Engine Electrical Wiring Harness: Left Side
Figure 203 (Sheet 1 of 4)

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Key to Figure 203

1. Engine Wiring Harness Anti-icing Valve Connector
2. Screw
3. Engine Wiring Harness EEC Interogator Connector
4. Bracket
5. Nut
6. Grounding Cable
7. EEC Interogator Plug
8. Nut
9. Grounding Cable
10. Bolt
11. Bolt
12. Loop Clamp Assembly
12A. Loop Clamp Assembly
13. Self-locking Nut
14. Angle Bracket
15. Angle Bracket
16. Loop Clamp Assembly
17. Bolt
18. Wiring Harness N2 Speed Sensor Connector
19. Grounding Cable
20. Wiring Harness N2 Speed Sensor Connector
21. HMU
22. Wiring Harness HMU Connector
23. Wiring Harness HMU
24. Loop Clamp Assembly

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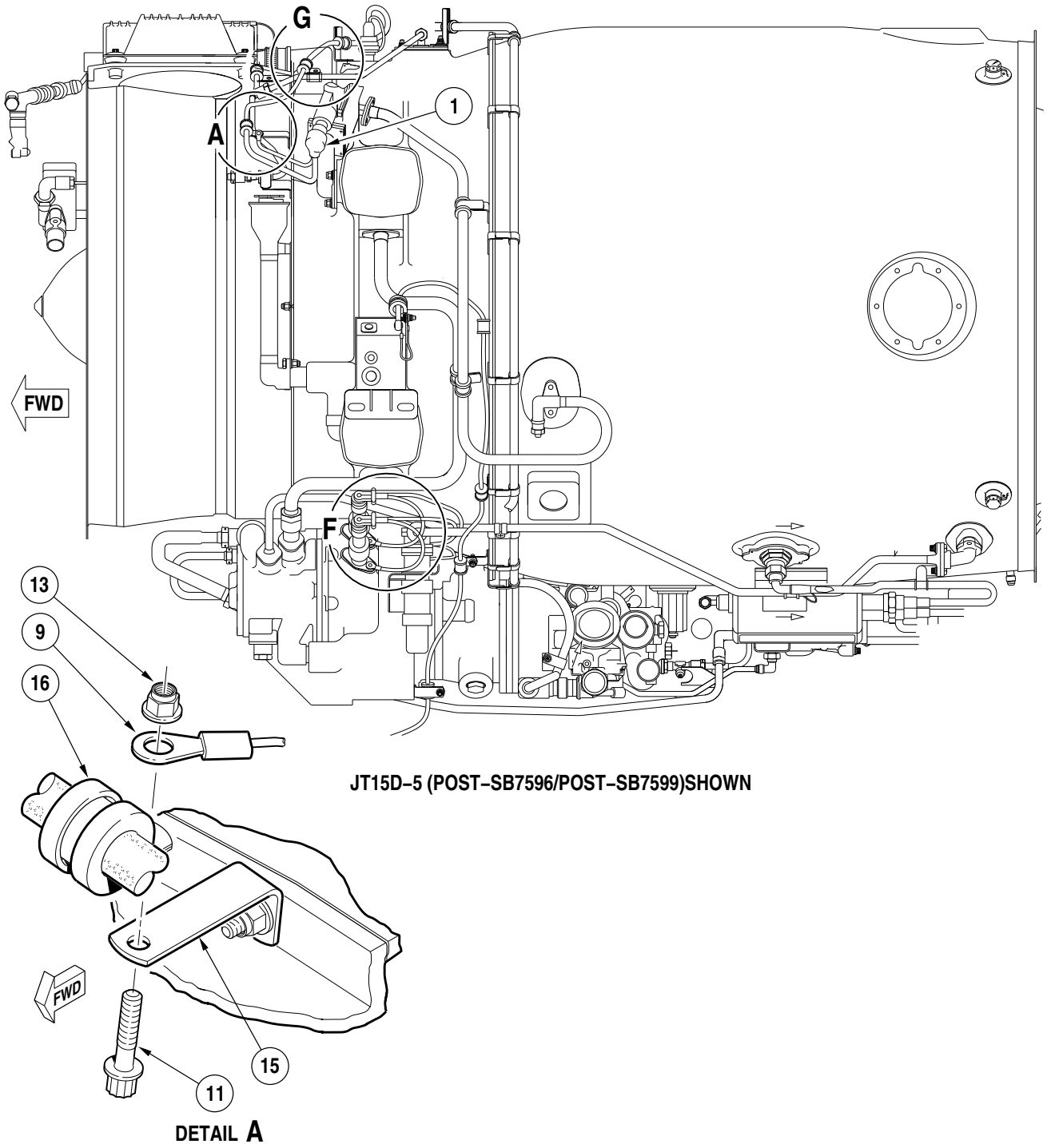

JT15D–5 (POST–SB7596/POST–SB7599)SHOWN

JT15D-5 C96938A

Removal/Installation - Engine Electrical Wiring Harness: Left Side
Figure 203 (Sheet 2)

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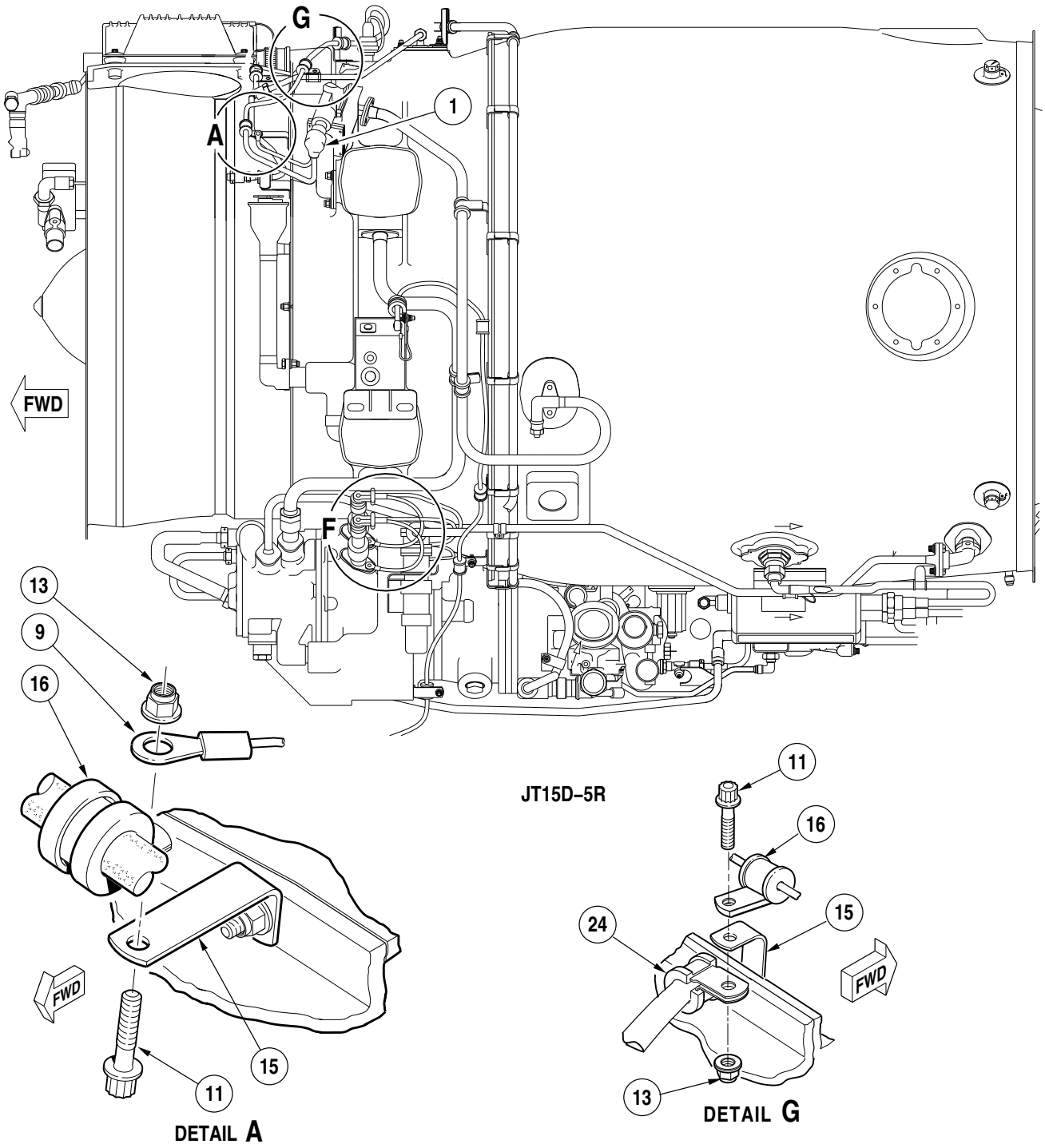

JT15D-5R C112881

Removal/Installation - Engine Electrical Wiring Harness: Left Side
Figure 203 (Sheet 3)

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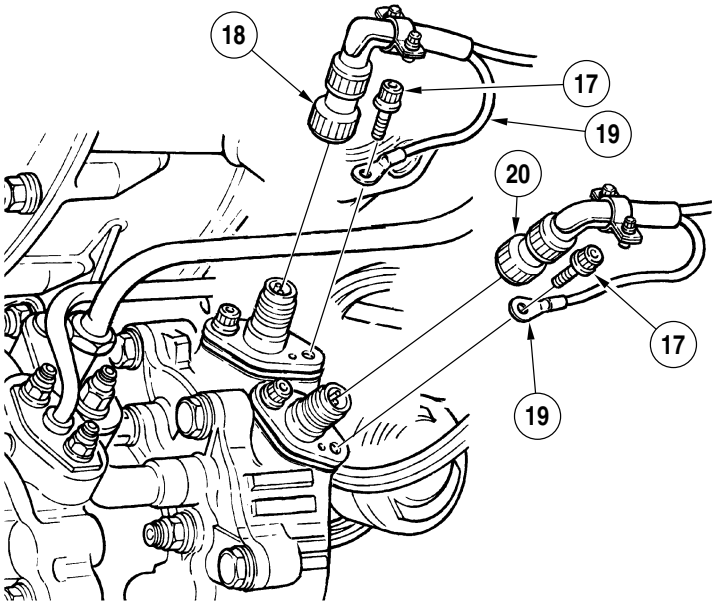
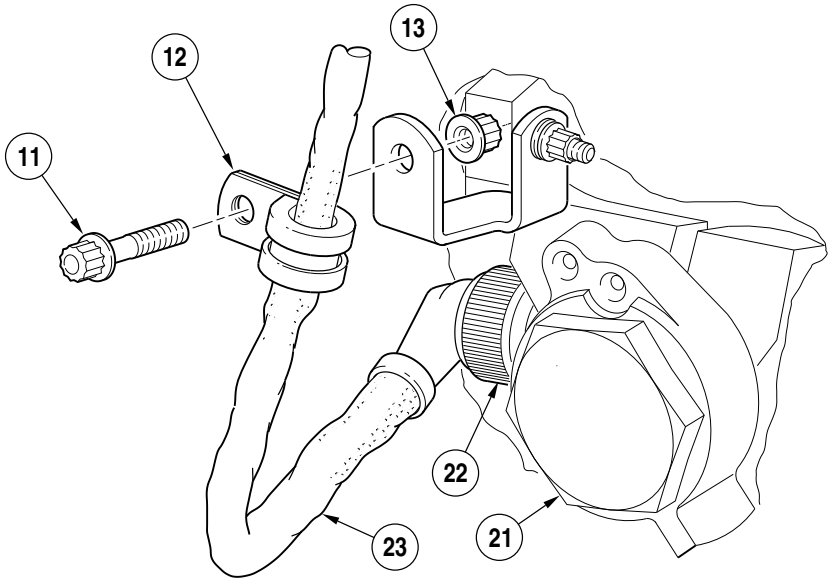


DETAIL F



DETAIL E
JT15D–5 (POST–SB7305/SB7597)
AND JT15D–5R

JT15D-5 AND JT15D-5R C96989C

Removal/Installation - Engine Electrical Wiring Harness: Left Side
Figure 203 (Sheet 4)

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(c) For JT15D-5R, refer to Detail G: secure harness anti-icing solenoid cable loop clamp (16) and upper vent tube loop clamp (24) to Flange A angle bracket (15) with bolt (11) and nut (13). Tighten and torque the nut to 36 to 40 lb.in.

(d) Refer to Detail D:

1 Secure wiring harness J7 EEC interrogator connector (3) to the mounting bracket (4) with four screws (2) and four nuts (8). Tighten the nuts to 7 to 8 lb.in.

2 Secure the interrogator plug (7) to the mating wiring harness EEC interrogator connector (3). Apply lockwire to secure the plug.

3 Secure grounding cables (6) and (9) to the bracket (4) with one bolt (10) and one nut (5). Tighten the nut to 36 to 40 lb.in.

(e) Refer to Detail F:

1 Connect harness P9 connector (18) to the upper N2 speed sensor. Tighten the connector fingertight plus 45 degrees. Apply lockwire to secure the connector.

2 Connect harness P6 connector (20) to the lower N2 speed sensor. Tighten the connector with your hand plus 45 degrees. Apply the lockwire to attach the connector.

NOTE: The P6 connector cable is on the same cable as the harness interrogator plug connector (3).

3 Remove the two rear bolts (17) securing each N2 speed sensor. Secure grounding cables (19) for P6 and P9 connectors with the bolts (17) at the two N2 speed sensor mounting locations. Tighten and torque the bolts to 24 to 36 lb.in. Secure each N2 speed sensor connector to N2 sensor bolts with lockwire.

(f) Refer to Detail E:

1 JT15D-5 (Post-SB7305) and JT15D-5R engines (View D): secure loop clamp (12) on the HMU connector cable (23) to HMU double-angle bracket with one bolt (11) and one nut (13). Tighten and torque the nut to 36 to 40 lb. in.

2 Connect harness P2 HMU connector (22) to mating connector on the HMU. Tighten the connector fingertight plus 45 degrees. Apply lockwire to secure the connector.

(g) Refer to Detail C: secure loop clamps (12) and (12A) on oil tube and cable (23) with one bolt (11) and one nut (13). Tighten and torque the nut to 36 to 40 lb. in.

(h) Refer to lower Detail B: secure wiring harness N2 sensor/HMU cable (23) to two remaining Flange B angle brackets (14) with two bolts (11) and two nuts (13) at two locations. Tighten and torque the nuts to 36 to 40 lb. in.

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(i) Refer to upper Detail B: secure wiring harness N2 sensor/HMU cable (23) to Flange B angle brackets (14) with four bolts (11) and four nuts (13) at four locations. Tighten and torque the nuts to 36 to 40 lb. in.

(7) **Installation of Harness on Right Side of Engine (Ref. Fig. 204):**

(a) **For Right Side of a Left Engine Only:**

1 Refer to Detail B: secure T1 harness, Po tube and engine wiring harness aircraft connector cable clamps (2), (4) and (5) to Flange A angle bracket (6) with bolt (7), spacer (3) and nut (1). Tighten and torque the nut to 36 to 40 lb.in.

2 JT15D-5 (Pre-SB7597): refer to Detail C. Secure wiring harness aircraft connector cable clamp (11) to Flange A angle bracket (10) with bolt (7) and nut (1). Tighten and torque the nut to 36 to 40 lb.in.

(b) **All Engines:**

1 For JT15D-5 engines, refer to Detail E and F: secure three loop clamps (14) on bleed valve solenoid cable (9) and loop clamps (13) on T1 harness to Flange B angle brackets (12) with three bolts (7) and nuts (1). Tighten and torque the nuts to 36 to 40 lb.in.

2 For JT15D-5R engines, refer to Detail E: secure loop clamp (17) on anti-siphon pressure oil tube (18) and loop clamp (13) on bleed valve solenoid cable to Flange B angle bracket (12) with bolt (7) and nut (1). Tighten and torque the nuts to 36 to 40 lb.in.

3 For JT15D-5R engines, refer to Detail F: secure two loop clamps (14) on T1 harness (9), two loop clamps (13) on bleed valve solenoid cable and two clamps (17) on anti-siphon pressure oil tube (18) to Flange B angle brackets (12) with two bolts (7) and nuts (1). Tighten and torque the nuts to 36 to 40 lb.in.

4 Refer to Detail D: secure three loop clamps (14), (15) and (16) with one bolt (7) and one nut (1). Tighten and torque the nut to 36 to 40 lb.in.

5 Connect engine wiring harness P11 bleed valve actuator connector (8) to mating connector on the anti-icing solenoid valve. Tighten the connector fingertight plus 45 degrees. Apply lockwire to secure the connector.

(8) After installation of new or replacement engine wiring harness, refer to Airframe Maintenance Manual for required functional checks.

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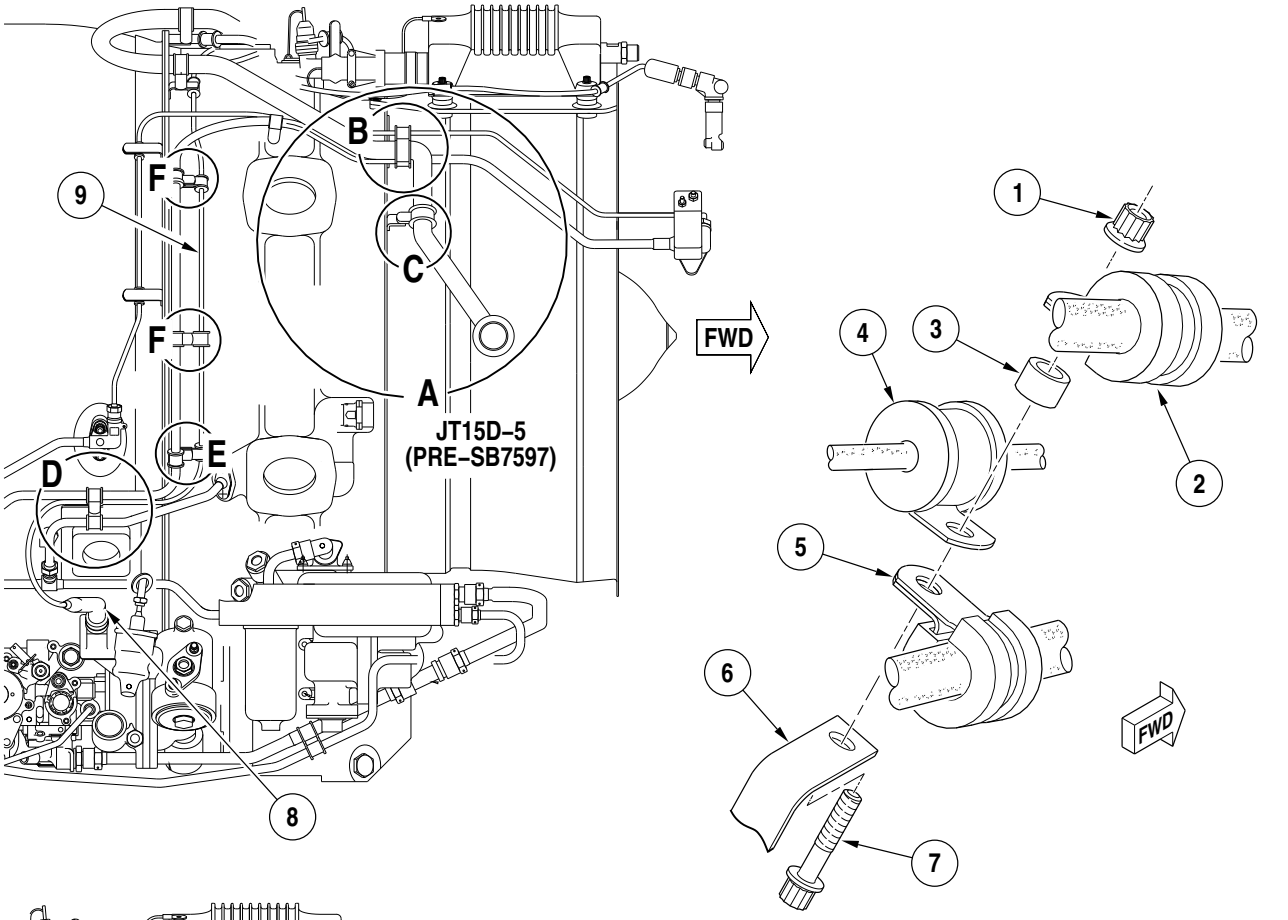
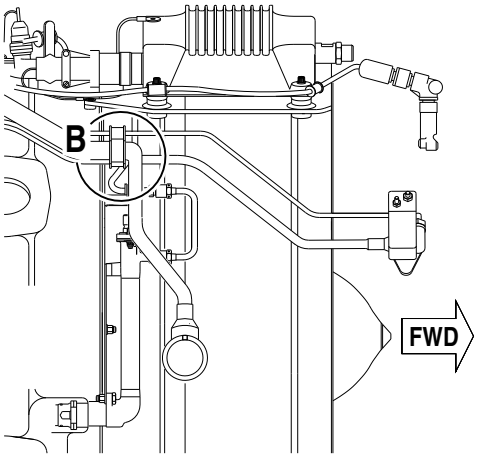


DETAIL B



DETAIL A
JT15D–5 (POST–SB7597/ POST–SB7496)

NOTE:

LEFT–HAND ENGINE IS SHOWN. CLAMPING DETAILS SHOWN FOR WIRING HARNESS BLEED VALVE ACTUATOR CABLE APPLY TO RIGHT–HAND AND LEFT–HAND ENGINES.

LEFT ENGINE SHOWN (JT15D-5) C96934A

Removal/Installation - Engine Electrical Wiring Harness: Right Side
Figure 204 (Sheet 1 of 3)

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Key to Figure 204

1. Bolt
2. Loop Clamp Assembly
3. Spacer
4. Loop Clamp Assembly
5. Loop Clamp Assembly
6. Angle Bracket
7. Self-locking Nut
8. Wiring Harness Bleed Valve Actuator Connector
9. Wiring Harness Bleed Valve Actuator Cable
10. Angle Bracket
11. Loop Clamp Assembly
12. Angle Bracket
13. Loop Clamp Assembly
14. Loop Clamp Assembly
15. Loop Clamp Assembly
16. Loop Clamp Assembly
17. Loop Clamp Assembly (JT15D-5R)
18. Anti-Siphon Pressure Oil Tube (JT15D-5R)

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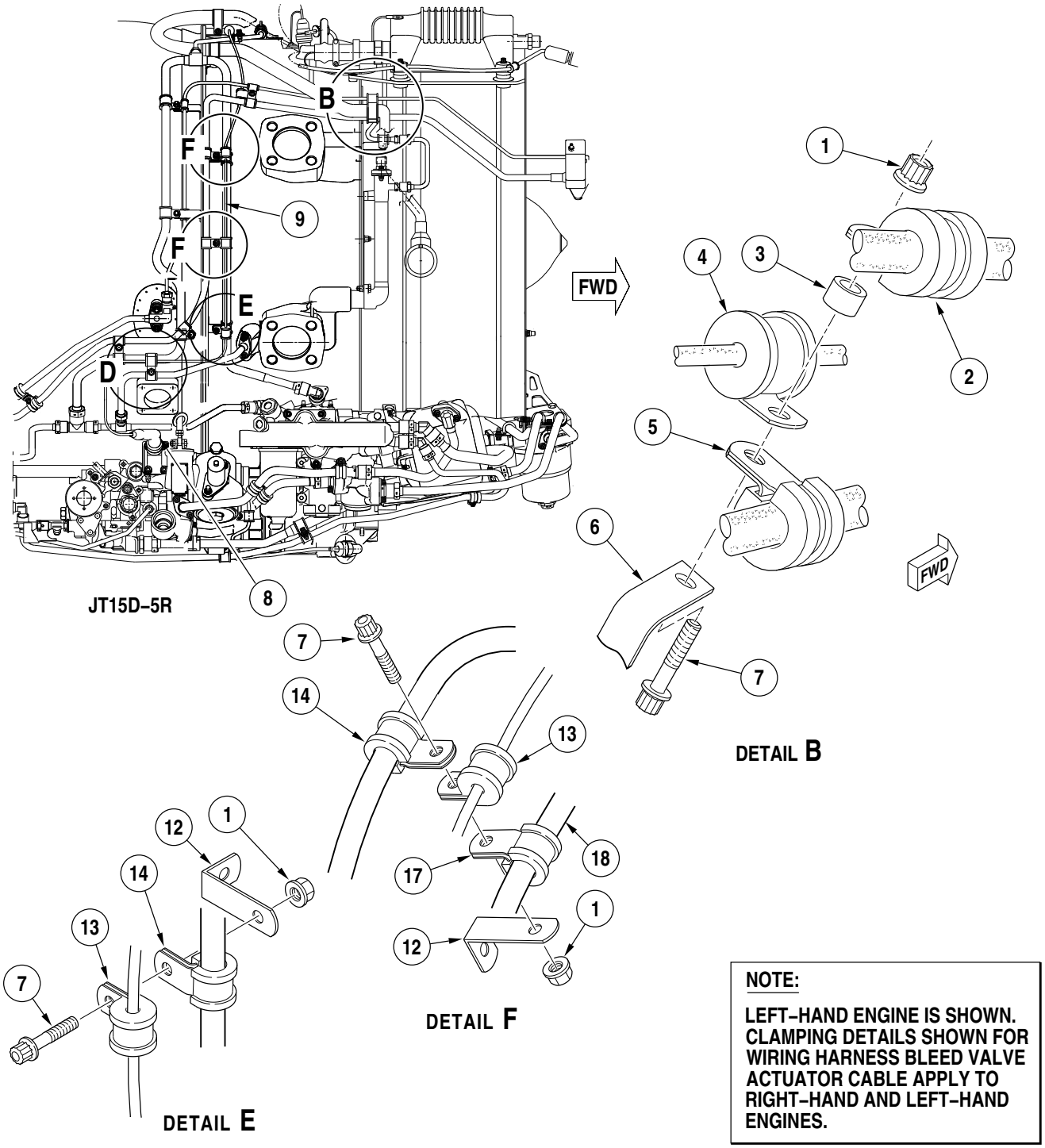

LEFT ENGINE SHOWN (JT15D-5R) C112882

Removal/Installation - Engine Electrical Wiring Harness: Right Side
Figure 204 (Sheet 2)

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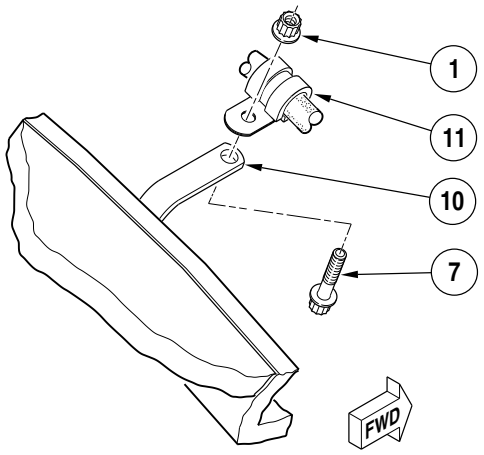
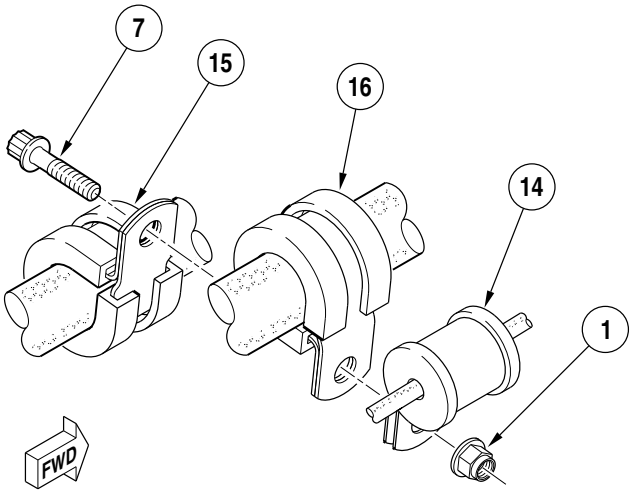
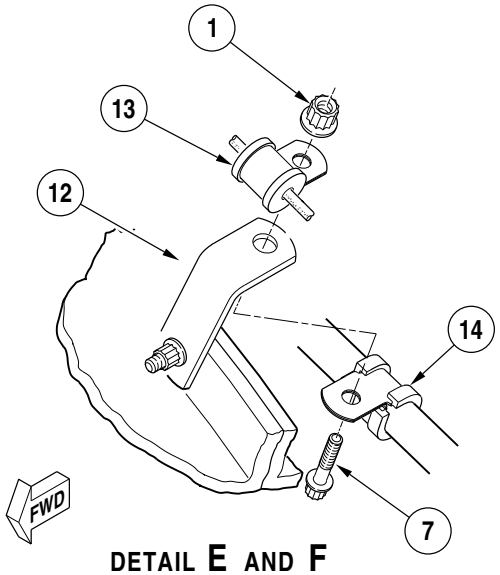


DETAIL C
JT15D–5 (PRE–SB7597)



DETAIL D
JT15D–5R



DETAIL E AND F
JT15D–5

JT15D-5 AND JT15D-5R C97328C

Removal/Installation - Engine Electrical Wiring Harness: Right Side
Figure 204 (Sheet 3)

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6. Cleaning

A. Wiring Harness Connectors

CAUTION: DO NOT EXPOSE HARNESS CABLE OR RUBBER COMPONENTS IN CONNECTORS TO SOLVENTS FOR LONG PERIODS. EXPOSURE MAY DAMAGE CABLE OR CONNECTORS.

(1) Wipe connector shell thoroughly using a clean, lint-free cloth moistened with cleaning solvent (PWC11-035) or (PWC11-023). Remove visible deposits using a clean, non-abrasive brush.

(2) Apply deoxidizer solvent (PWC11-036) to contact pins or sockets and connector shell using spray, brush or swab and allow five minutes for solvent to act.

CAUTION: DO NOT EXPOSE HARNESS CABLE OR RUBBER COMPONENTS IN CONNECTORS TO SOLVENTS FOR LONG PERIODS. EXPOSURE MAY DAMAGE CABLE OR CONNECTORS.

(3) Wash connector with cleaning solvent (PWC11-035) or (PWC11-023). Drain connector and dry using clean compressed air at 30 psig maximum.

(4) Allow one hour for solvent to fully evaporate before installing connector.

7. Inspection/Check

Visually inspect engine wiring harness for general condition, signs of damage, broken wires, worn insulation and security.

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SPEED AND TEMPERATURE SENSORS - DESCRIPTION AND OPERATION

1. Description

   A. Rotor Speed Sensing System

      Three speed sensors, one mounted at the 12 o'clock position on the intermediate case and two located on the accessory gearbox left-hand side, sense low (N1) and high (N2) compressor rotor speeds, respectively. Each sensor is electrically connected to the engine electronic control unit (EEC), mounted at the 12 o'clock position on the inlet case.

   B. N1 Speed Sensor (Ref. Fig. 1)

      N1 rotor speed is sensed electrically by a magnetic transducer (speed sensor) in conjunction with a 24 equally-spaced toothed wheel integral to the LP compressor shaft. The speed sensor is housed in the top half of the intermediate case. The lower end of the sensor is screwed into a flanged insert located in the extended rear flange of the No. 1 bearing housing. The upper end of the sensor, embodying the flanged, four-pin output connector, is secured to a pad on top of the intermediate case.

   C. N2 Speed Sensors

      Each N2 speed sensing unit consists of a magnetic transducer (speed sensing sensor pole piece) located at a set distance from an 88 tooth oil pump drive gear (pulse generator). The AGB is driven by the high compressor (N2) rotor. An accessory gear in the AGB meshes with and drives the oil pump drive and pulse generator gear, allowing high compressor rotor speed to be transmitted to the N2 speed sensors.

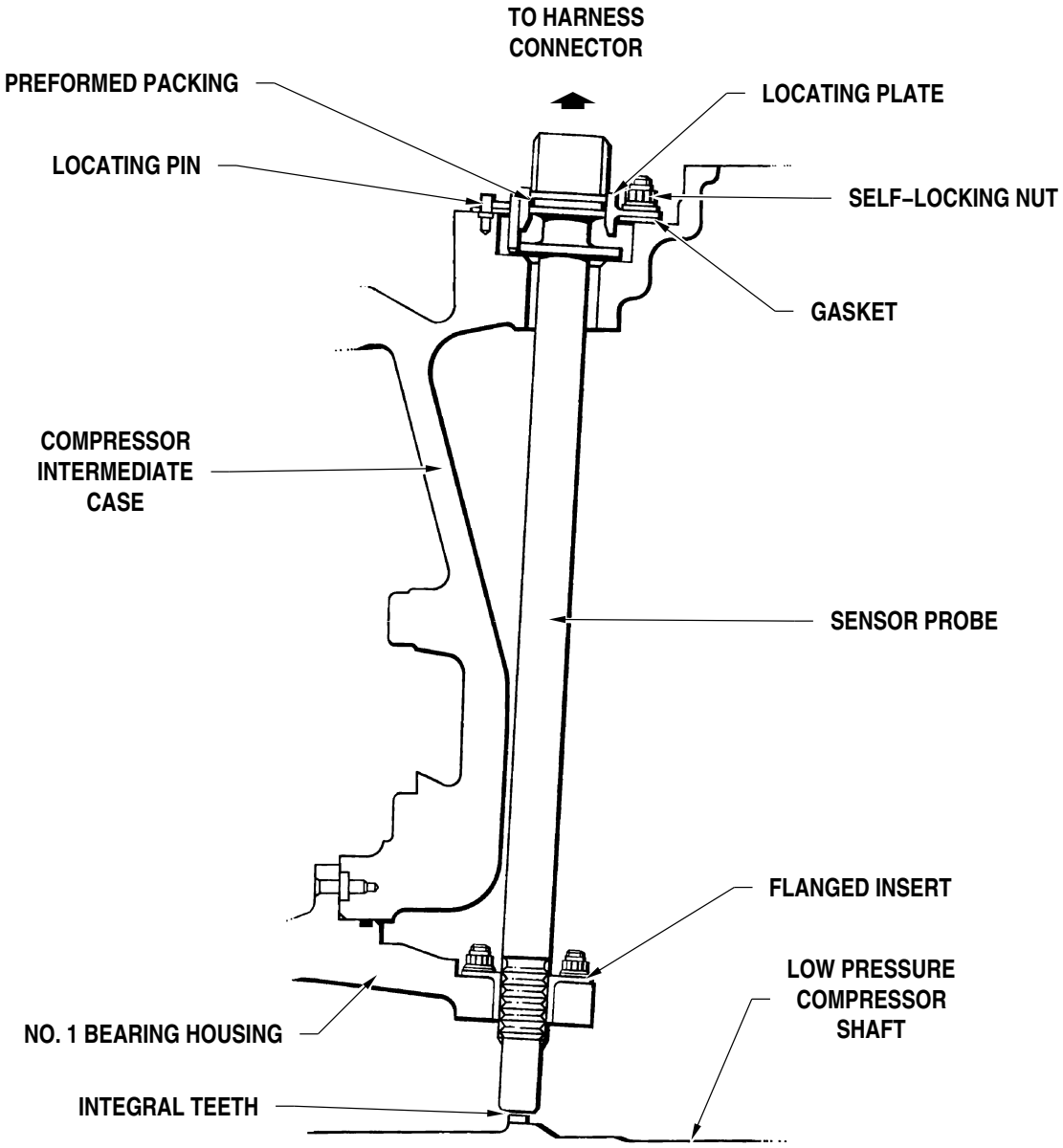
   D. To Temperature Sensor

      The temperature sensor (To) is a line-replaceable unit mounted in the airframe engine intake duct, directly in front of the engine LP compressor case. The sensor projects into the engine air flow immediately before the LP compressor case at approximately the 11 o'clock position. A four-pin electrical connector accepts a cable from the engine electrical wiring harness. The To sensor incorporates two electrical circuits: a temperature sensor circuit for the engine EEC and a separate integral anti-icing heater circuit to keep the probe air inlet free of ice. Power for the temperature sensor heater circuit is supplied by the aircraft (airframe connector) via the engine wiring harness.

2. Operation

   A. N1 and N2 Speed Sensors

      Rotation of N1 and N2 compressor rotors induces a voltage in the sensor magnetic sensor circuit. Because of the pulse generator tooth profile, the induced voltage varies, resulting in a pulsating electromotive force (EMF), the frequency being a function of high compressor shaft rotational speed. This EMF is transmitted to the airframe and EEC via the engine electrical wiring harness.



N1 Speed Sensor
Figure 1

B. To Temperature Sensor

A platinum resistor in the To sensor is subjected to ambient air temperature of engine air flow immediately in front of the LP compressor inlet case. The purpose of the sensor is to convert the ambient air temperature to an electrical signal which is sent to the EEC. Logic within the EEC uses the To signal, along with other inputs to determine engine speeds.

SPEED SENSORS - FAULT ISOLATION

1. Fault Isolation

   Refer to Chapter 72-00-00, FAULT ISOLATION, Fault Isolation for Engine Operating Problems.

SPEED AND TEMPERATURE SENSORS - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance procedures for the HP and LP rotor speed sensors and for the To temperature sensor.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC11-023	Cleaning Solvent
PWC11-035	Cleaning Solvent, Electrical Contacts
PWC11-036	Electrical Deoxidizer Solvent

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   The fixtures, equipment and supplier tools listed below are used in the following procedures.

Name	Remarks
Electrical Test Set, Insulation Tester	Megger MJ10 Model No. 8842A

5. Removal/Installation

   A. Removal of LP Compressor Shaft (N1) Speed Sensor (Ref. Fig. 201)

      (1) Disconnect harness connector (1) from N1 speed sensor (2).

      (2) Remove four self-locking nuts (3) securing N1 speed sensor (2) to housing. Remove terminal of ground strap (5) from stud.

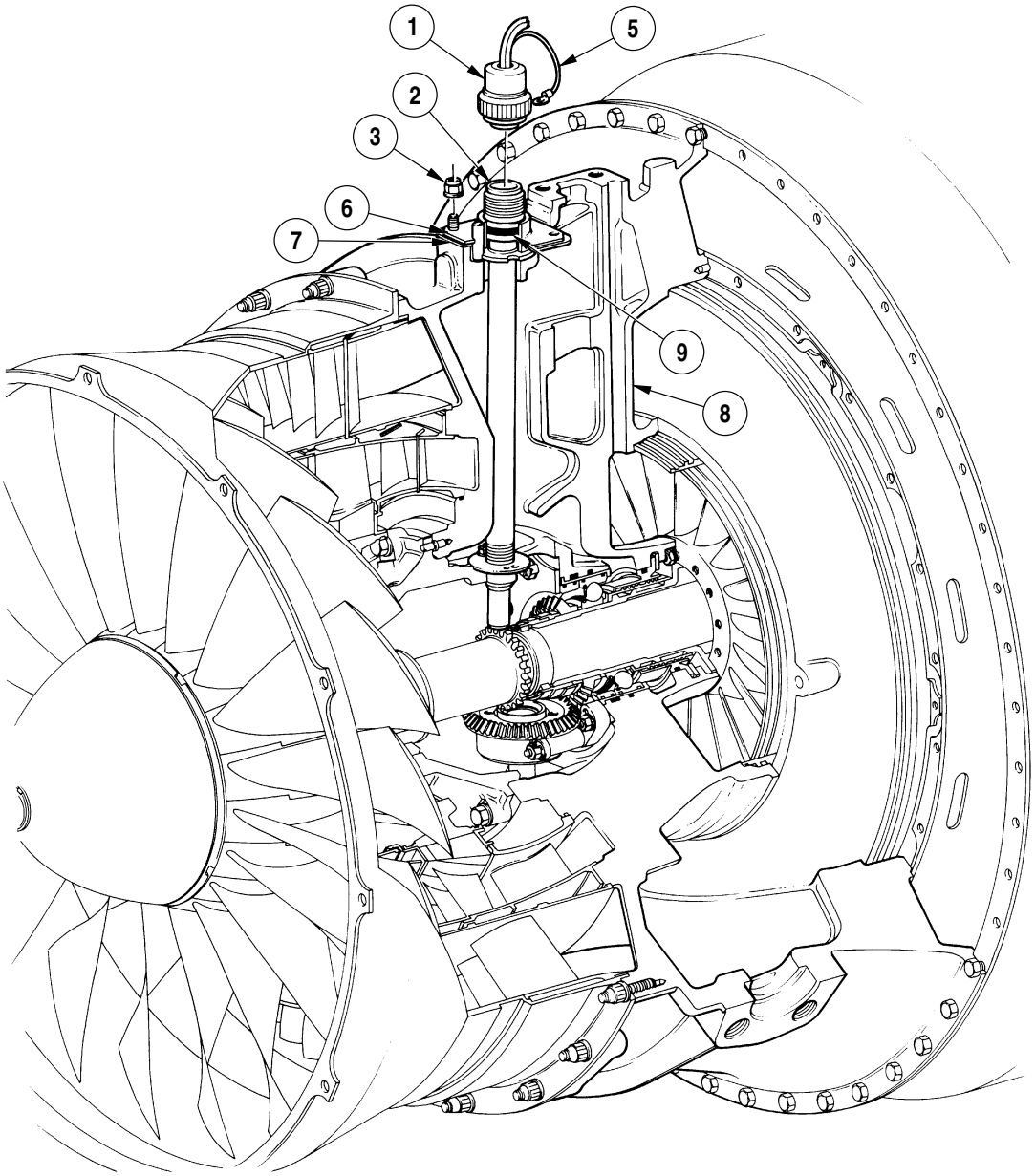
      (3) Remove locating plate (6) and gasket (7) from housing. Discard gasket.

      (4) Carefully unscrew N1 speed sensor (2) and remove sensor from intermediate case (8). Discard preformed packing (9).

   B. Installation of LP Compressor Shaft (N1) Speed Sensor (Ref. Fig. 201 and Fig. 202)

      (1) Install new preformed packing (9) on speed sensor (2). Install N1 speed sensor (2) into mount pad at 12 o'clock position on intermediate case and set gap between speed sensor and integral teeth on LP compressor rotor shaft as follows:

         (a) While turning LP compressor shaft slowly by hand, carefully tighten N1 speed sensor (2) until light contact is felt. Note location of scallop pattern at upper flange (Ref. Fig. 202, Detail A).



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Removal/Installation - N1 Speed Sensor
Figure 201

Key to Figure 201

1. Engine Wiring Harness Connector
2. N1 Speed Sensor
3. Self-locking Nut
4. Not used
5. Ground Strap
6. Locating Plate
7. Gasket
8. Intermediate Case
9. Preformed Packing

(b) Rotate sensor CCW the minimum angle (Ref. Details A and B) required to align any scallop with a longitudinal or transverse axis. This scallop becomes the reference scallop.

NOTE: The alignment scallop is the first scallop CCW to the reference scallop.

(c) Rotate sensor counterclockwise a further 108 degrees. This rotation is to position the alignment scallop opposite the initial reference point along the same axis (Ref. Detail C).

(d) Install new gasket (7, Fig. 201) and lockplate (6) so that pin engages alignment scallop (Ref. Fig. 202, Detail D).

(2) Install four self-locking nuts (3, Fig. 201) on studs, tighten and torque nuts to 65 to 85 lb.in.

(3) Connect harness connector (1) to speed sensor (2). Tighten connector handtight plus 45 degrees. Secure with lockwire.

C. Removal of HP Compressor Shaft (N2) Speed Sensors (Ref. Fig. 203)

(1) Disconnect wiring harness electrical connector (4) from N2 speed sensor (7) .

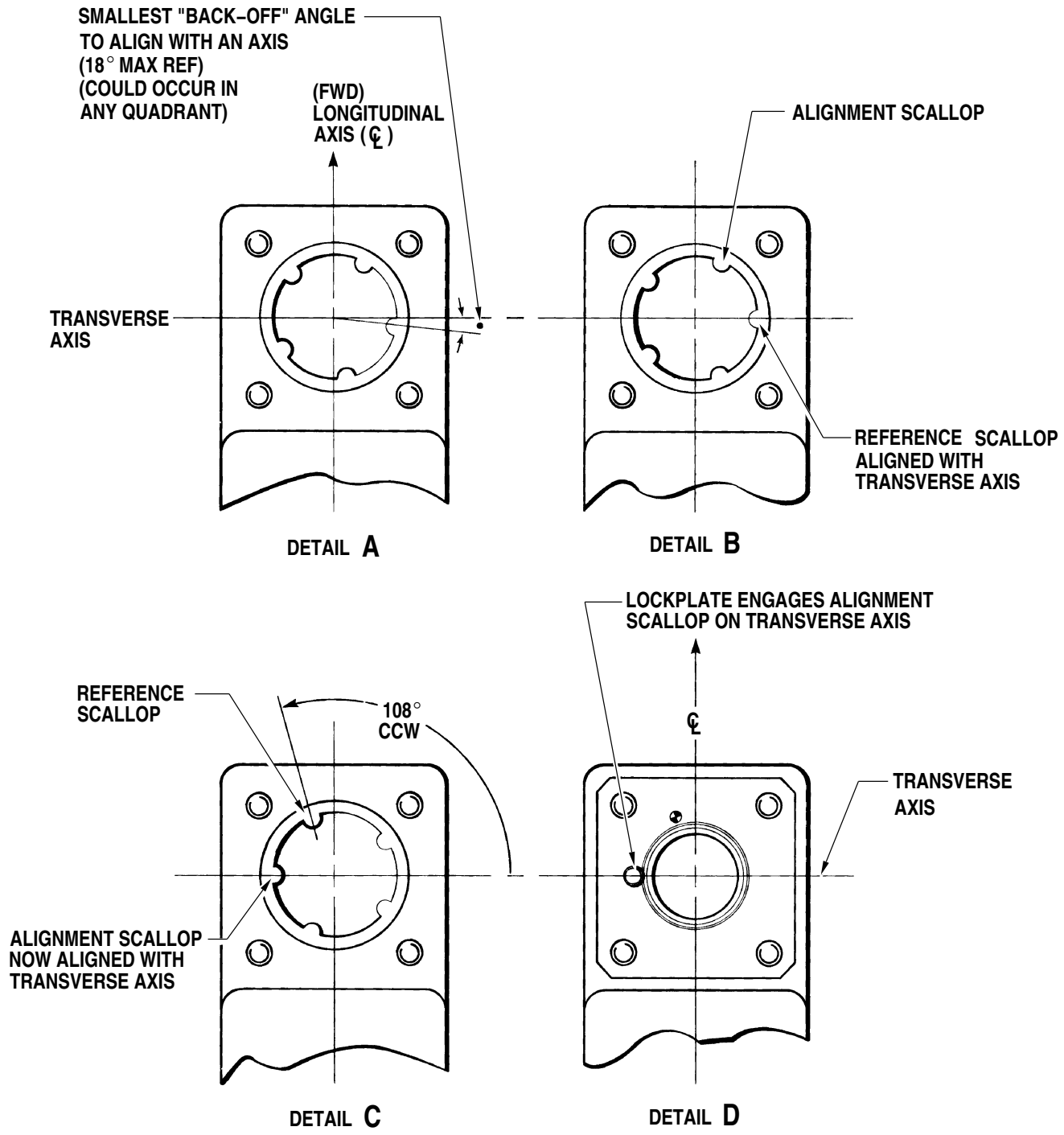
(2) Cut lockwire and remove two bolts (1) securing N2 speed sensor (7) and adjusting plate (6) to AGB housing (8). Remove terminal of ground cable (5) .

CAUTION: SENSORS AND ADJUSTING PLATES MUST BE RETAINED AS A SET AND INSTALLED IN THEIR ORIGINAL LOCATIONS.

(3) Remove sensor (2) and adjusting plate (6) from housing. Retain adjusting plate with sensor.

(4) Remove and discard preformed packing (9) from sensor (7).

(5) Repeat steps (1) through (4) for second sensor.



C11442A

N1 Speed Sensor - Setting Gap between Sensor and Shaft
Figure 202

D. Installation of HP Compressor Shaft (N2) Speed Sensor (Ref. Fig. 203)

CAUTION: N2 SPEED SENSOR ADJUSTING PLATE THICKNESS MUST BE CORRECTLY CALCULATED IF REPLACEMENT ACCESSORY GEARBOX, OIL PUMP, SENSOR OR ADJUSTING PLATE IS INSTALLED.

(1) Establish correct clearances between N2 speed sensors and oil pump drive spur gear as follows:

(a) Measure dimension A on uninstalled N2 speed sensor (2) or (7). Record dimension. If replacement speed sensor is to be installed, etch position characters #1 and #2 as appropriate onto upper or lower speed sensor flange.

(b) Measure dimension B, from outer face of boss on AGB housing to oil pump drive spur gear. Rotate gear 360 degrees and note point with smallest clearance. Record smallest reading as Dimension B.

(c) Calculate thickness of adjusting plate required to give correct clearance using formula:

1 (Dimension A + 0.008 inch - Dimension B) ± 0.002 inch = target adjusting plate thickness.

2 Measure actual adjusting plate thickness and compare to target thickness value. If required, grind adjusting spacer to obtain target thickness. Spacer faces must be flat within 0.0002 inch and parallel to each other within 0.002 inch.

(d) Electrolytic etch thickness dimension and character #3 on ground face of adjusting plate (6) for upper N2 speed sensor (2). Etch thickness dimension and character #2 on adjusting plate (6) for lower speed sensor (7). Depth of etching must not exceed 0.002 inch. Keep N2 sensor and matching adjusting plate as a set.

(e) Repeat steps (a) through (d) for remaining N2 speed sensor.

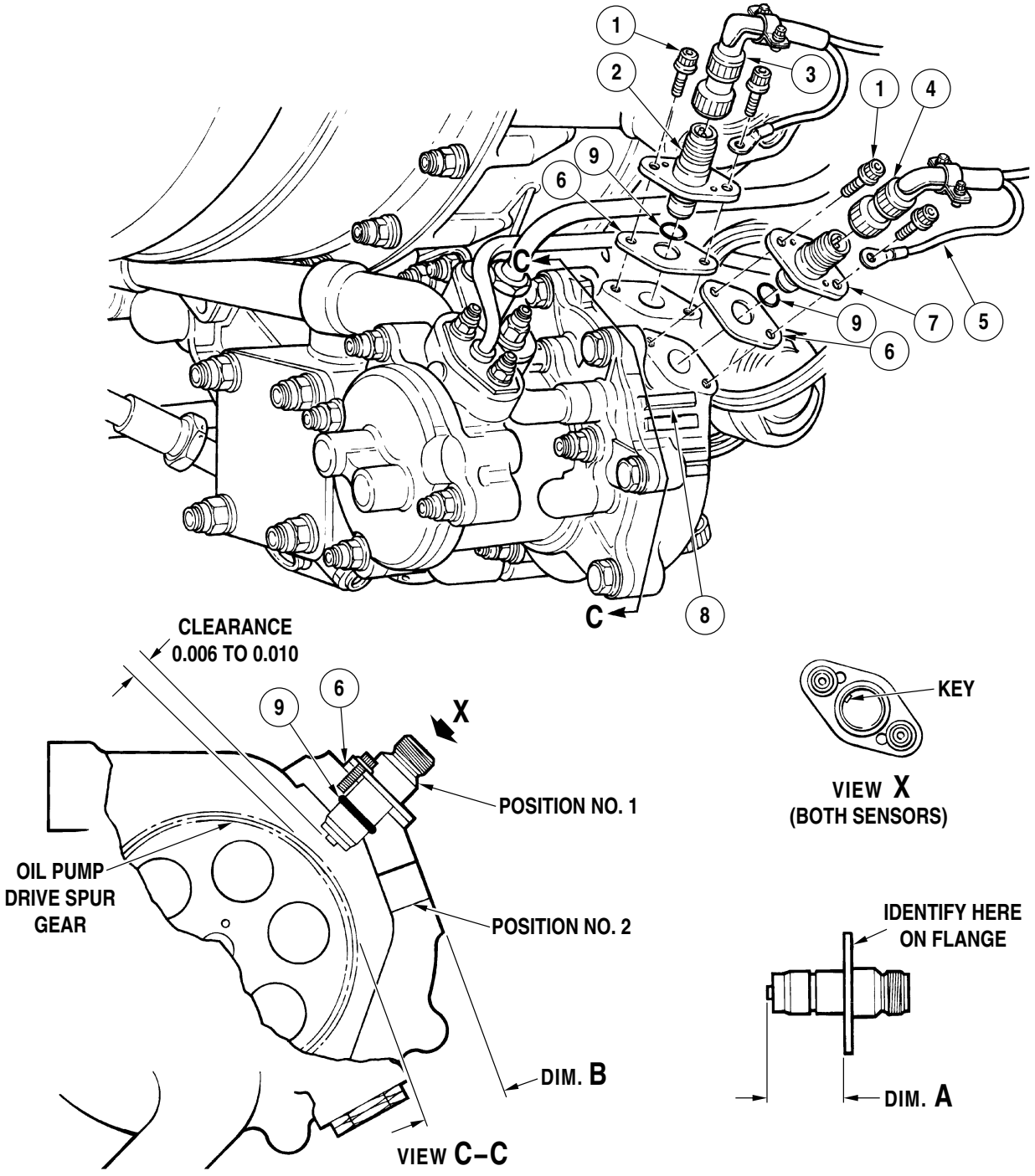
(2) Install new preformed packing (9) on N2 speed sensors (2) and (7).

CAUTION: SPEED SENSORS AND ADJUSTING PLATES MUST BE INSTALLED AT THEIR ORIGINAL LOCATIONS. DO NOT MIX SPEED SENSORS AND ADJUSTING PLATES.

(3) Install adjusting plates (6) of correct dimension onto matching speed sensors (2) and (7). Install speed sensor (2) with adjusting plate at upper position #1 on AGB housing. Install speed sensor (7) with adjusting plate at lower position #2. Check that sensors are installed with key to correct side (Ref. View X).

(4) Secure N2 speed sensors (2) and (7), with adjusting plates (6) and ground cables (5) with four bolts (1). Torque bolts 24 to 36 lb.in. and lockwire.

(5) Install engine wiring harness electrical connectors (3) and (4) onto receptacles on N2 speed sensors (2) and (7). Tighten connector handtight plus 45 degrees and lockwire.



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Removal/Installation - N2 Speed Sensors
Figure 203

Key to Figure 203

1. Bolt
2. N2 Speed Sensor
3. Engine Wiring Harness N2 Speed Sensor Electrical Connector
4. Engine Wiring Harness N2 Speed Sensor Electrical Connector
5. Ground Cable
6. Adjusting Plate
7. N2 Speed Sensor
8. Accessory Gearbox
9. Preformed Packing

E. Removal of To Temperature Sensor (Ref. Fig. 204)

(1) Remove To temperature sensor (3) from location on aircraft (Ref. Airframe Maintenance Manual).

(2) Remove lockwire securing engine wiring harness cable connector connector (2) to To temperature sensor (3).

(3) Loosen and remove engine wiring harness cable connector connector (2). Remove To temperature sensor (3).

F. Installation of To Temperature Sensor (Ref. Fig. 204)

(1) Install To temperature sensor (3) onto aircraft (Ref. Airframe Maintenance Manual).

(2) Secure engine wiring harness cable connector connector (2) to electrical connector on To temperature sensor (3). Tighten connector fingertight and lockwire.

6. Cleaning

A. Speed Sensors

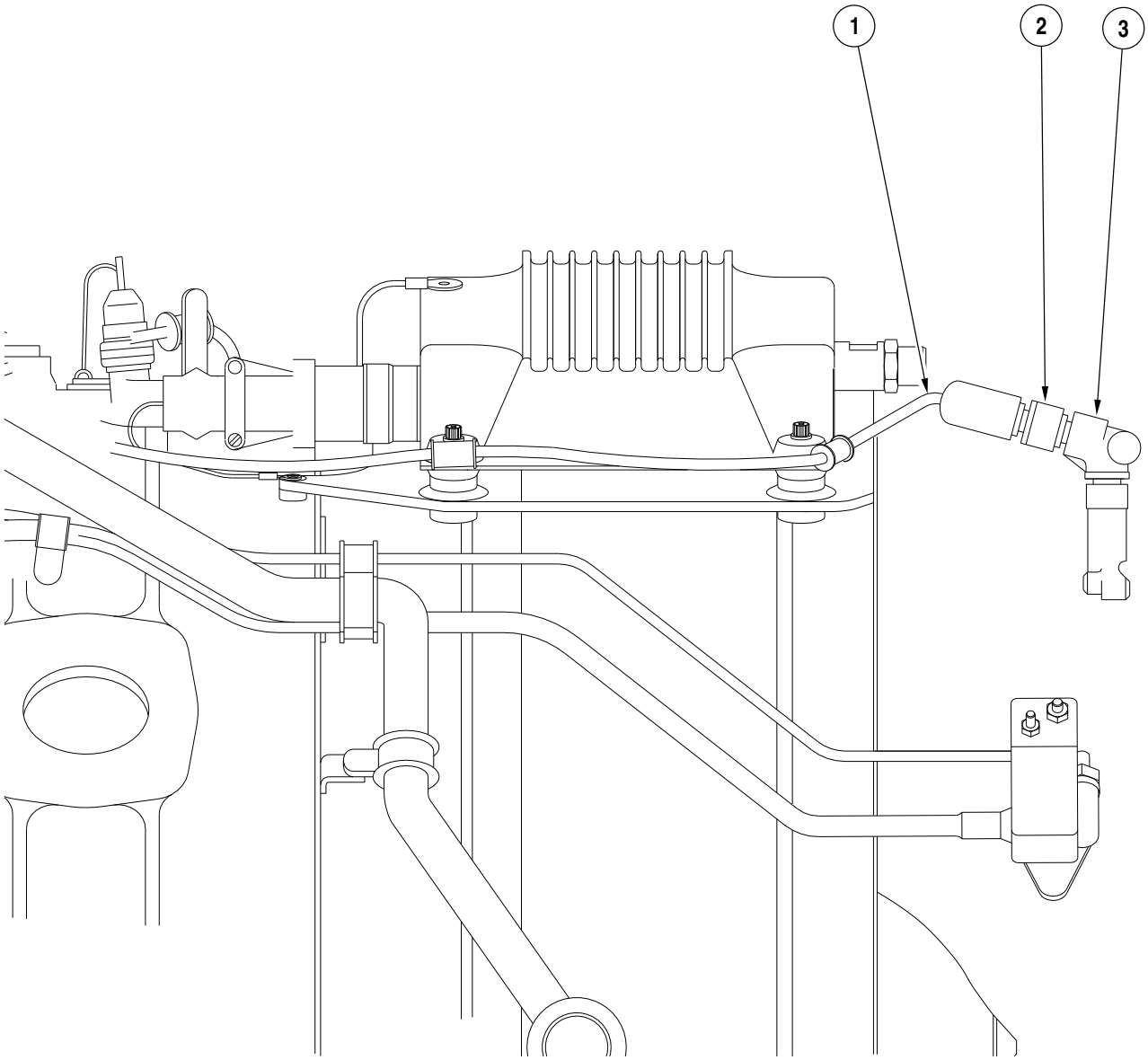
(1) Wipe sensor thoroughly using a clean, lint-free cloth moistened with cleaning solvent (PWC11-035) or (PWC11-023). Remove visible deposits using a clean, non-abrasive brush.

(2) Apply deoxidizer solvent (PWC11-036) to inside of sensor connector well and pins using spray, brush or swab and allow five minutes for solvent to act.

(3) Wash sensor with cleaning agent (PWC11-035) or (PWC11-023). Invert connector and allow to drain.

(4) Dry sensor using clean compressed air at 30 psig maximum.

(5) Allow one hour for solvent to fully evaporate before installing sensor.



LEFT–HAND ENGINE SHOWN

C77381

Removal/Installation - To Temperature Sensor
Figure 204

Key to Figure 204

1. Engine Wiring Harness To Sensor Cable
2. Engine Wiring Harness To Sensor Cable Electrical Connector
3. To Temperature Sensor

B. To Temperature Sensor

CAUTION: DO NOT CLEAN To TEMPERATURE SENSOR USING ULTRASONIC METHOD. HANDLE AND REMOVE FOREIGN MATERIAL FROM SENSOR WITH CARE.

(1) Blow clean, oil-free compressed air into the air exit slots in the side of the housing or at the rear of the To sensor to remove all foreign material blocking air slots.

(2) To clean air inlet slots, prepare a solution of commercially available detergent and clean tap water. Use a syringe to inject air inlet slots with detergent/water solution, then rinse with clean tap water. Blow clean, oil-free compressed air into the probe's air exit slots to remove moisture. Dry probe per step (3)(e) below.

(3) To remove heavier soil from temperature sensor, including electrical connector well, proceed as follows:

(a) Soak To sensor in detergent/water solution for 10 to 30 minutes.

(b) Shake the probe in the solution to remove foreign material from the sensor's air slots.

(c) Rinse the probe thoroughly with clean tap water.

(d) Blow clean, oil-free compressed air into the probe's air exit slots to remove moisture.

(e) Dry the probe by placing it in an oven at 250 °F for 15 minutes.

7. Inspection/Check

A. Visual Inspection of Speed Sensors

(1) Inspect N1 speed sensor for general condition, damage to threading on probe barrel and scallops. Reject sensor with cracks on barrel.

(2) Inspect N2 speed sensors for general condition and damage to electrical connector threading or bolt holes. Reject sensor with cracks on barrel.

(3) Reject sensor showing evidence of broken or rubbed magnetic probe tip. Reject sensor with any marks or scoring damage on face of probe.

(4) Inspect electrical connector end. Reject sensor with broken or bent connector pins, chipped pin sealant or cracked mounting flange.

(5) Check electrical connector pins for corrosion, dirt and contamination using a 16X magnifying glass.

B. Electrical Check of N1 Rotor Speed Sensor (Ref. Fig. 205)

(1) Measure continuity (loop) resistance of N1 rotor speed sensor using Model 8842A continuity tester (Ref. 72-00-00, Maintenance Practices, Special Fixtures and Equipment), or other sutable test set, as follows:

(a) Continuity (loop) resistance value between pins A and B must be 1100 ohms minimum to 1400 ohms maximum.

(b) Continuity (loop) resistance value between pins C and D must be 36 ohms minimum to 55 ohms maximum.

(2) Measure insulation resistance of pins A through D to body of sensor using Megger MJ10 insulation tester or other suitable test set (Ref. 72-00-00, Maintenance Practices, Special Fixtures and Equipment). Resistance should be 20 megohms minimum at 100 volts DC.

C. Electrical Check of N2 Rotor Speed Sensors (Ref. Fig. 205)

(1) Measure DC continuity (loop) resistance of N2 sensor by connecting Model 8842A contuinity tester (Ref. 72-00-00, Maintenance Practices, Special Fixtures and Equipment), or other suitable test set, to pins A and B. Continuity (loop) resistance should measure between 257 to 477 ohms.

(2) Separately, measure insulation resistance of pin A and pin B to body of sensor using Megger MJ10 insulation resistance tester or other suitable test set (Ref. 72-00-00, Maintenance Practices, Special Fixtures and Equipment). Resistance should be 20 megohms minimum at 100 volts DC.

D. Visual Inspection of To Temperature Sensor

(1) Inspect To sensor for general condition and damage to electrical connector threading or bolt holes. Reject sensor with cracks.

(2) Check air inlet an pressure port holes for blockage. Remove any foreign material (Re. Cleaning).

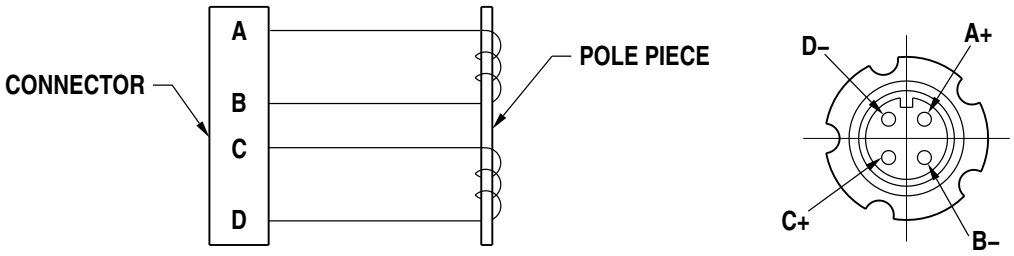
(3) Inspect electrical connector end. Reject sensor with broken or bent connector pins, chipped pin sealant or cracked mounting flange.

(4) Check electrical connector pins for corrosion, dirt and contamination using a 16X magnifying glass. Remove foreign material (Ref. Cleaning).

E. Electrical Check of To Temperature Sensor (Ref. Fig. 206)

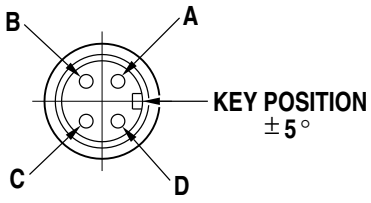
(1) Measure continuity (loop) resistance of To temperature:

(a) Connect leads of multimeter, or other suitable test set, to terminals A and B. Continuity (loop) resistance value must be between 100 and 140 ohms.



N1 SPEED SENSOR

N2 SPEED SENSOR



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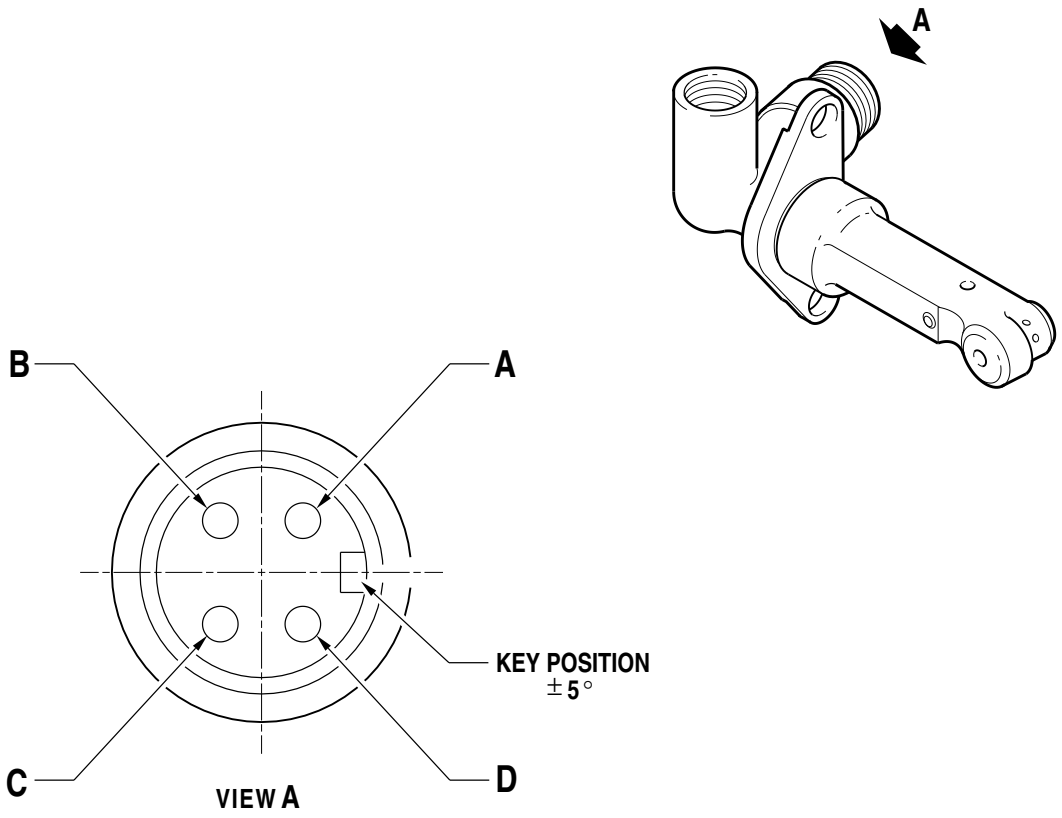
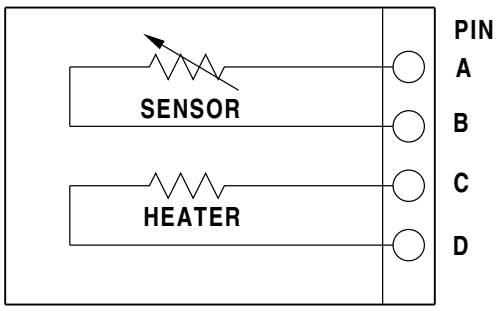
N1 and N2 Sensors - Electrical Check
Figure 205





ELECTRICAL SCHEMATIC DIAGRAM
To TEMPERATURE SENSOR

C77359

Electrical Check of To Temperature Sensor
Figure 206

(b) Connect leads of multimeter, or other suitable test set, to terminals C and D (heater resistance). Continuity (loop) resistance value must be between 5 and 9 ohms.

(2) Measure insulation resistance of pins A or B and D or C to body of sensor using suitable test set. Resistance should be 10 megohms minimum at 50 volts DC.

8. Fits, Clearances and Torque Loadings

A. Refer to Table 201 and Figure 207.

TABLE 201, Fits and Clearances

REF. NO.	Name	Dim. for Ref. (inches)		Limits (inches)		
		Min.	Max.	Min.	Max.	Replace
1309	Clearance - Speed Sensor - Compressor Shaft			0.0167	0.0194	

TABLE 202, Torque and Stretch

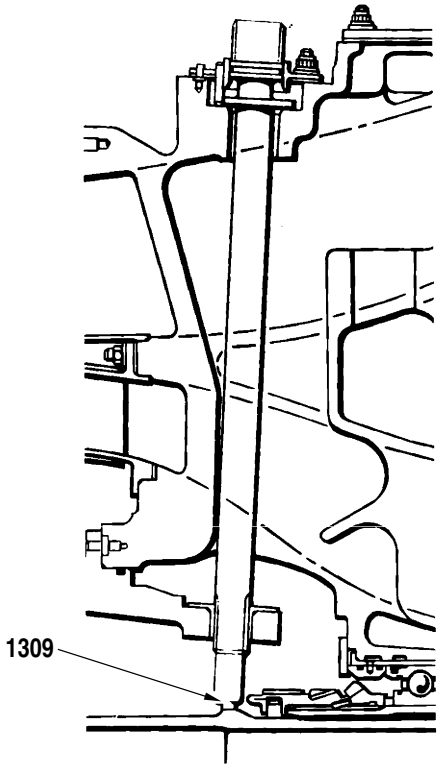
REF. NO.	Name	Limits	
		Min.	Max.
	Not Applicable		

TABLE 203, Spring Pressure

REF. NO.	Name	Limits	
		Min.	Max.
	Not Applicable		

TABLE 204, Special Assembly

REF. NO.	Name	Limits Min.	Limits Max.
Not Applicable			



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Fits, Clearances and Torque Loadings
Figure 207

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
LEP	1	Oct 06/2006
	2 blank	Oct 06/2006
Contents	1	Oct 06/2006
	2 blank	Oct 06/2006
74-00-00	1	Oct 06/2006
Description and Operation	2	Oct 06/2006
74-00-00	101	Oct 22/99
Fault Isolation	102 blank	Oct 22/99
74-00-00	201	Oct 22/99
Maintenance Practices	202	Oct 22/99

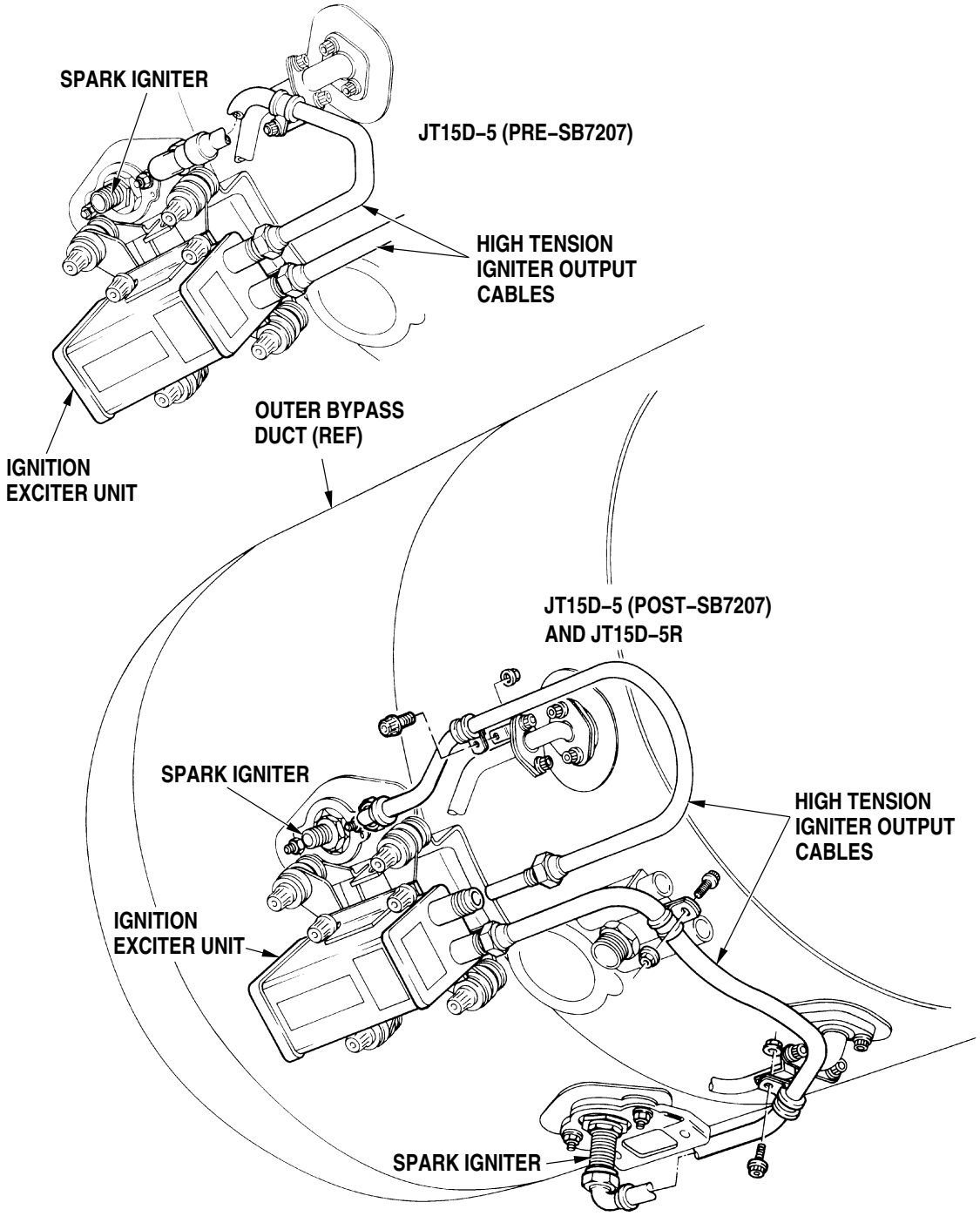
TABLE OF CONTENTS

SUBJECT	PAGE
IGNITION - DESCRIPTION AND OPERATION	**74-00-00**
1. General	1
IGNITION - FAULT ISOLATION	**74-00-00**
1. IGNITION - MAINTENANCE PRACTICES	101
IGNITION - MAINTENANCE PRACTICES	**74-00-00**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Adjustment/Test	201
A. Operational Check	201

IGNITION - DESCRIPTION AND OPERATION

1. General (Ref. Fig. 1)

   The spark ignition system has been developed to provide the engine with an ignition system capable of quick lightups over a wide temperature range.The spark ignition system comprises one exciter unit, two individual high tension cable assemblies and two spark igniters. The system is energized from the aircraft nominal 28 volt DC supply and will operate in the 9 to 30 volt range.



Ignition System Components
Figure 1

IGNITION - FAULT ISOLATION

1. IGNITION - MAINTENANCE PRACTICES

For detailed fault isolation procedures for engine ignition system, refer to 72-00-00, FAULT ISOLATION .

IGNITION - MAINTENANCE PRACTICES

1. General

   A. The ignition system may be tested for correct operation while the engine is installed in the airframe, or with the engine installed in the maintenance stand.

2. Consumable Materials

   Not Applicable

3. Special Tools

   The special tools listed below are used in the following procedures.

Tool No.	Name
PWC31276	Plug, Blanking, Ignition Exciter

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Adjustment/Test

   A. Operational Check

   WARNING: VOLTAGE USED IN IGNITION SYSTEM IS DANGEROUSLY HIGH. BEFORE DISASSEMBLING ANY PART OF SYSTEM, SWITCH IGNITION OFF, DISCONNECT INPUT TO EXCITER AND ALLOW AT LEAST SIX MINUTES TO ELAPSE BEFORE FURTHER WORK. ALWAYS USE INSULATED TOOLS TO REMOVE COUPLING NUTS . DO NOT TOUCH OUTPUT CONNECTORS OR COUPLING NUTS WITH BARE HANDS.

   (1) Switch ignition system OFF.

   (2) Disconnect one exciter output- to-igniter cable at exciter unit (Ref. 74-10-01). Install plug (PWC31276) in disconnected exciter connector port.

   CAUTION: BEFORE SWITCHING ON IGNITION TO PERFORM OPERATIONAL CHECK, ACCOMPLISH A DRY MOTORING RUN (REF. 71-00-00, ADJUSTMENT/TEST) TO ENSURE THAT NO FUEL REMAINS IN GAS GENERATOR CASE.

   (3) Switch ignition ON.

   (4) Listen for regular frequency snapping sound. Switch ignition OFF.

   (5) Remove plug (PWC31276) from exciter connector. Reconnect igniter cable to exciter unit and remove other lead from other exciter unit. Repeat steps (3) and (4), preceding.

   (6) If snapping sound is not heard on either check, replace ignition exciter (Ref. 74-10-01) and repeat steps (1) through (5), preceding.

(7) If snapping sound is not heard on one check only, replace associated spark igniter (Ref. 74-20-02) and/or ignition cable (Ref. 74-20-01), and repeat operational check. If spark igniter still fails, replace ignition exciter.

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
LEP	1	May 13/2013
	2 blank	May 13/2013
Contents	1	May 13/2013
	2 blank	May 13/2013
74-10-01 Description and Operation	1	Oct 22/99
	2 blank	Oct 22/99
74-10-01 Maintenance Practices	201	May 13/2013
	202	May 13/2013
	203	May 13/2013
	204	May 13/2013

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The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
IGNITION EXCITER - DESCRIPTION AND OPERATION	**74-10-01**
1. General	1
2. Ignition Exciter	1
IGNITION EXCITER - MAINTENANCE PRACTICES	**74-10-01**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Remove Ignition Exciters	201
B. Installation of Ignition Exciters	203
6. Inspection/Check	203
A. Procedure	203
7. Cleaning/Painting	204
A. Corrosion	204

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IGNITION EXCITER - DESCRIPTION AND OPERATION

1. General

The ignition exciter is mounted and secured to a bracket assembly located at the 7 o'clock position on the outer bypass duct. Mounting assemblies feature four flexible absorption mounts interposed between the ignition exciter and the bypass duct or intermediate case mounting pads. These isolate the exciter from the bypass duct and intermediate case, thus dampening engine-induced vibration effects.

2. Ignition Exciter

The ignition exciter is a sealed unit containing electronic components encased in an epoxy resin. The unit is energized only during the engine starting sequence to initiate combustion in the combustion chamber. The exciter transforms the d.c. input to a pulsed high voltage output through solid state circuitry, a transformer and diodes.

When the unit is energized, a capacitor on the high voltage side of the output transformer is progressively charged, until the energy stored, approximately four joules, is sufficient to ionize a spark gap in the unit and discharge the capacitor across the two spark igniters through a dividing and step-up transformer network. The network is designed so that if one igniter is open or shorted, the remaining igniter will continue to function. The network also enables the capacitor to discharge automatically in the event of either or both igniters becoming inoperative, or if the input voltage is switched off.

IGNITION EXCITER - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the ignition exciters.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC06-005	Dry Spray Lubricant
PWC11-005	Envirosolv 655
PWC11-012	Acetone
PWC11-014	Isopropyl Alcohol
PWC11-022	DELETED
PWC11-023+	Ardrox Leeder 1064K
PWC11-025+	Desoclean 45

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Remove Ignition Exciters (Ref. Fig. 201)

      (1) Isolate power from ignition system.

      WARNING: VOLTAGE USED IN IGNITION SYSTEM IS DANGEROUSLY HIGH. BEFORE DISASSEMBLING ANY PART OF SYSTEM, SWITCH IGNITION OFF, DISCONNECT INPUT TO EXCITER AND ALLOW AT LEAST SIX MINUTES TO ELAPSE BEFORE FURTHER WORK. ALWAYS USE INSULATED TOOLS TO REMOVE COUPLING NUTS . DO NOT TOUCH OUTPUT CONNECTORS OR COUPLING NUTS WITH BARE HANDS.

      (2) Remove lockwire and disconnect ignition cable assemblies (1) or (7) and (2) from spark igniters (3). Discharge any residual current in ignition exciter by grounding both cable electrodes to spark igniter shields. Loosely reconnect cable couplings to igniters.

      (3) Remove lockwire and disconnect igniter cable assemblies (1) or (7) and (2) from connectors of ignition exciter (4).

      (4) Remove four bolts (5) securing ignition exciter unit (4) to flexible mount assembly (6). Remove exciter.

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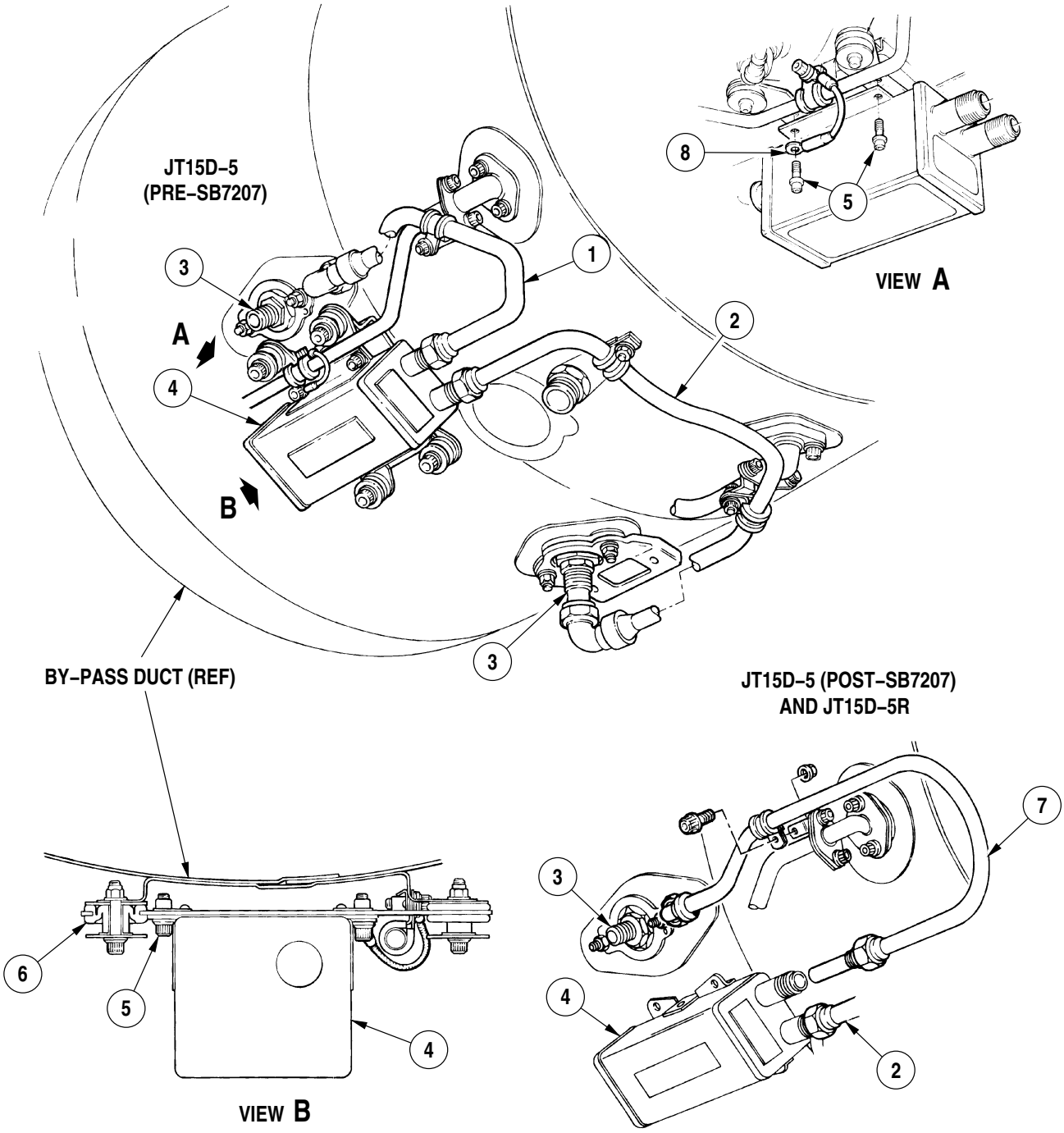

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Removal/Installation - Ignition Exciters
Figure 201

Key to Figure 201

1. Ignition Cable (JT15D-5 Pre-SB7207)
2. Ignition Cable
3. Spark Igniter Plug
4. Ignition Exciter Unit
5. Bolt
6. Flexible Mount Assembly
7. Ignition Cable (JT15D-5 Post-SB7207 and JT15D-5R)
9. Ground Cable (JT15D-5 Post-SB7298 and JT15D-5R)

B. Installation of Ignition Exciters (Ref. Fig. 201)

(1) Position ignition exciter (4) with airframe input connector to engine forward, on flexible mount assembly (6). Secure exciter and ground cable (8) with four bolts (5).

(2) Tighten bolts and torque to 32 to 36 lb.in.

CAUTION: UNDER NO CIRCUMSTANCES IS LUBRICANT CONTAINING GREASE OR SILICONE, OR LUBRICANTS SUCH AS PETROLATUM, TO BE USED ON ANY IGNITION COMPONENT.

CAUTION: DO NOT ALLOW ANY LUBRICANT TO COME IN CONTACT WITH CENTRAL CONDUCTORS OF CABLES. SUCH CONTACT MAY RESULT IN A HIGH RESISTANCE PATH, POSSIBLY GENERATING HEAT AND OXIDATION.

CAUTION: DO NOT APPLY ANY LUBRICANT ON CABLES FEATURING TEFLON INSULATED SLEEVES.

(3) Lightly spray outer surfaces of exciter connectors and rubber insulation of ignition cable (2) ends with dry spray lubricant (PWC06-005).

(4) Connect ignition cable assemblies (1) or (7) and (2) to connectors on ignition exciters (4). Tighten cable couplings 140 to 160 lb.in. and lockwire.

(5) Install ignition cable couplings on spark igniters (3). Tighten couplings 140 to 160 lb.in. and lockwire.

(6) Reconnect input cable to ignition exciter (Ref. Airframe Maintenance Manual).

(7) If a replacement ignition exciter was installed, perform required ground checks (Ref. 71-00-00, ADJUSTMENT/TEST).

6. Inspection/Check

A. Procedure

(1) Clean ignition exciter (Ref. Para. 7.).

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(2) Inspect ignition exciter for security, signs of damage and general condition.

(3) Inspect input and output connectors for damage, paying particular attention to connector threads for corrosion.

7. Cleaning/Painting

A. Corrosion

(1) Remove all corrosion residue using a stainless steel wire brush, taking care not to damage gold plating on the terminal pins.

(2) Clean affected surface thoroughly, use a clean lint-free cloth moistened with isopropyl alcohol (PWC11-014) or acetone (PWC11-012) or Ardrox Leeder 1064K (PWC11-023+) or Desoclean 45 (PWC11-025+) or Envirosolv 655 (PWC11-005+).

(3) Apply light film of spray lubricant (PWC06-005) to cleaned areas.

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LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
LEP	1	Oct 06/2006
	2 blank	Oct 06/2006
Contents	1	Oct 06/2006
	2	Oct 06/2006
74-20-01	1	Oct 22/99
Description and Operation	2	Oct 22/99
74-20-01	201	Oct 06/2006
Maintenance	202	Oct 06/2006
Practices	203	Oct 06/2006
	204	Oct 06/2006
	205	Oct 06/2006
	206	Oct 06/2006
74-20-02	1	Oct 22/99
Description and Operation	2	Oct 22/99
74-20-02	201	Oct 06/2006
Maintenance	202	Oct 06/2006
Practices	203	Oct 06/2006
	204	Oct 06/2006
	205	Oct 06/2006
	206	Oct 06/2006
	207	Oct 06/2006
	208 blank	Oct 06/2006

TABLE OF CONTENTS

SUBJECT	PAGE
IGNITION EXCITER CABLES - DESCRIPTION AND OPERATION	**74-20-01**
1. Ignition Exciter Cables	1
IGNITION EXCITER CABLES - MAINTENANCE PRACTICES	**74-20-01**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal of Ignition Exciter Cables :	201
B. Installation of Ignition Exciter Cables	203
6. Inspection/Check	206
A. Procedure	206
SPARK IGNITERS - DESCRIPTION AND OPERATION	**74-20-02**
1. Spark Igniters	1
SPARK IGNITERS - MAINTENANCE PRACTICES	**74-20-02**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal of Spark Igniters	201
B. Installation of Spark Igniters	201
6. Inspection/Check	203
A. Spark Igniters	203
7. Cleaning/Painting	205
A. Spark Igniters	205

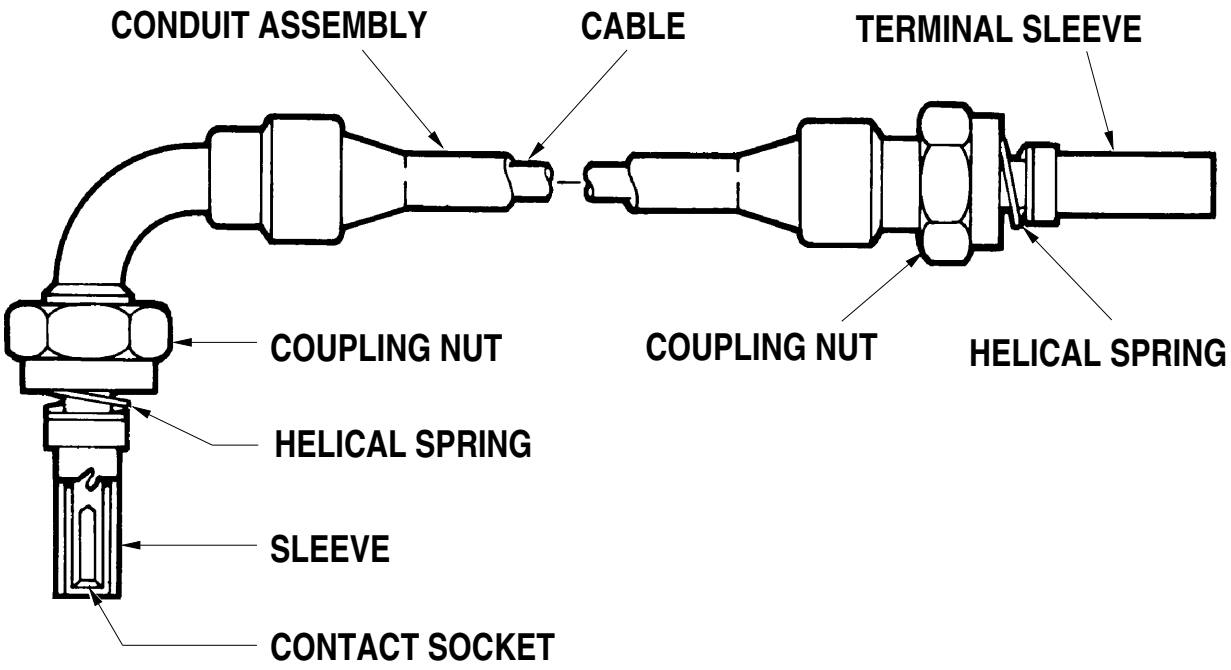
TABLE OF CONTENTS

SUBJECT	PAGE
SPARK IGNITERS - MAINTENANCE PRACTICES (Cont'd)	**74-20-02**
8. Fits and Clearances	205

IGNITION EXCITER CABLES - DESCRIPTION AND OPERATION

1. Ignition Exciter Cables

The two individual ignition cable assemblies (Ref. Fig. 1) carry the electrical energy output from the ignition exciters to the engine-mounted spark igniters. Each cable assembly consists of an electrical lead contained in a flexible metal braiding. Coupling nuts at each end of the assembly secure to connectors on ignition exciter and spark igniters.



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Ignition Exciter Cable Assembly (Typical)
Figure 1

IGNITION EXCITER CABLES - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the ignition exciter cables.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC06-005	Dry Spray Lubricant

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal of Ignition Exciter Cables (Ref. Fig. 201):

      (1) Isolate power from ignition system.

      CAUTION: VOLTAGE USED IN IGNITION SYSTEM IS DANGEROUSLY HIGH. BEFORE DISASSEMBLING ANY PART OF SYSTEM, SWITCH IGNITION OFF, DISCONNECT INPUT TO EXCITER AND ALLOW AT LEAST 6 MINUTES TO ELAPSE BEFORE FURTHER WORK. ALWAYS USE INSULATED TOOLS TO REMOVE COUPLING NUTS . DO NOT TOUCH OUTPUT CONNECTORS OR COUPLING NUTS WITH BARE HANDS.

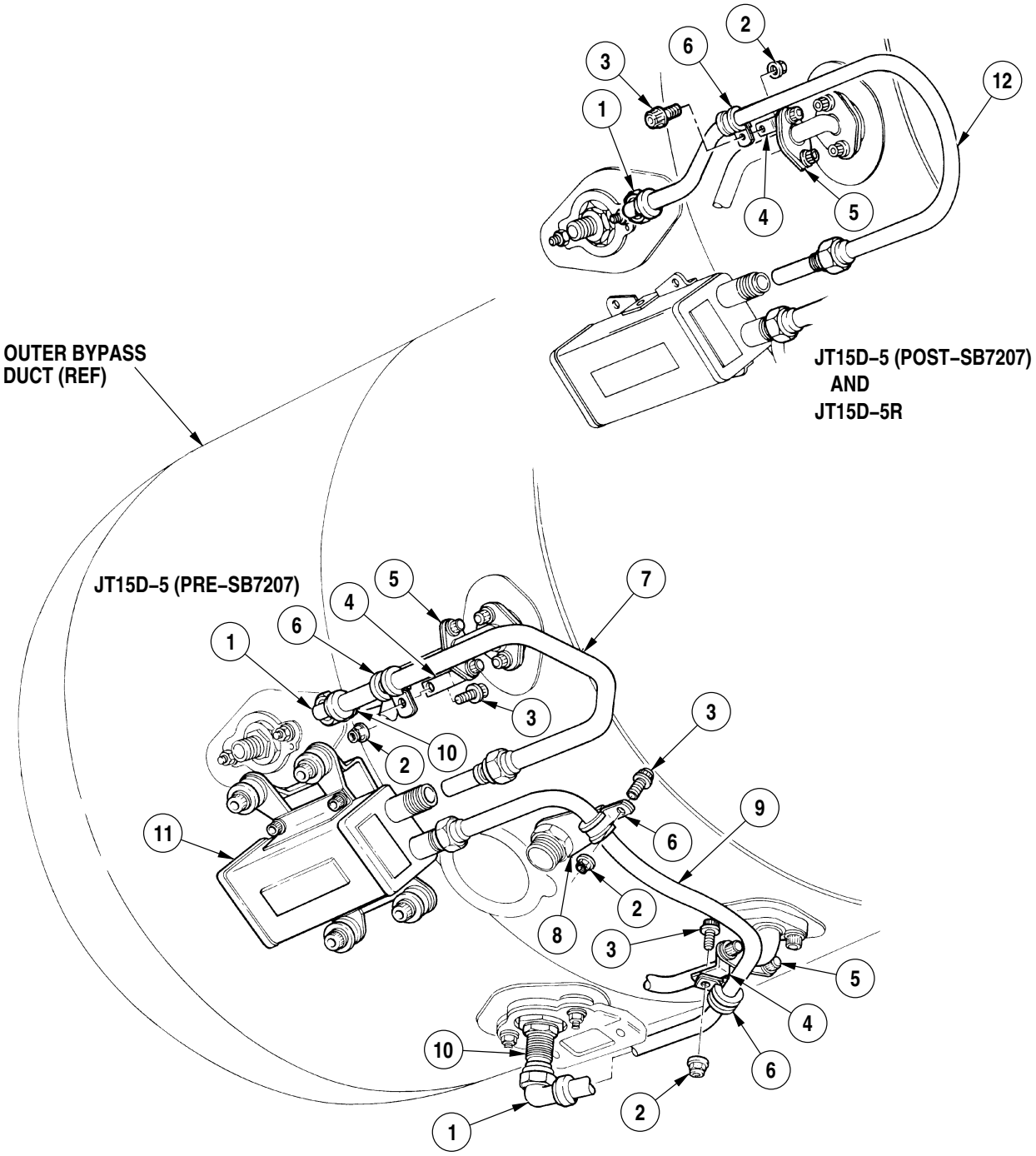
      (2) Remove three self-locking nuts (2) and three bolts (3) securing three loop clamp assemblies (6).

      (3) Remove attaching loop clamp assembly from ignition cable assemblies (7) or (12) and (9).

      (4) Remove lockwire and disconnect ignition exciter cable couplings (1) at spark igniters (10). Discharge any residual current in ignition exciter (11) by grounding both cable electrodes to spark igniter shields.

      NOTE: JT15D-5 (Pre-SB7207) engines: if difficulty is encountered removing igniter cable ends from either spark igniter or ignition exciter, the technique illustrated on Figure 202 may be employed.

      (5) Disconnect ignition cable couplings (1) at ignition exciter (11). Remove cables (7) or (12) and (9).



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Removal/Installation - Ignition Exciter Cables
Figure 201

Key to Figure 201

1. Coupling
2. Self-locking Nut
3. Bolt
4. Angle Bracket
5. Elbow
6. Loop Clamp Assembly
7. Igniter Cable Assembly (JT15D-5 Pre-SB7207)
8. Harness Connector Support Plate
9. Igniter Cable Assembly
10. Spark Igniter
11. Ignition Exciter Unit
12. Igniter Cable Assembly (JT15D-5 Post-SB7207 and JT15D-5R)

B. Installation of Ignition Exciter Cables (Ref. Fig. 201)

CAUTION: UNDER NO CIRCUMSTANCE IS LUBRICANT CONTAINING GREASE OR SILICONE, OR LUBRICANTS SUCH AS PETROLATUM, TO BE USED ON ANY IGNITION COMPONENT.

CAUTION: DO NOT ALLOW ANY LUBRICANT TO COME IN CONTACT WITH CENTRAL CONDUCTORS OF CABLES. SUCH CONTACT MAY RESULT IN A HIGH RESISTANCE PATH, POSSIBLY GENERATING HEAT AND OXIDATION.

CAUTION: DO NOT APPLY ANY LUBRICANT ON CABLES FEATURING TEFLON INSULATED SLEEVES.

(1) Lightly spray rubber insulation only at both ends of ignition cables with dry spray lubricant (PWC06-005).

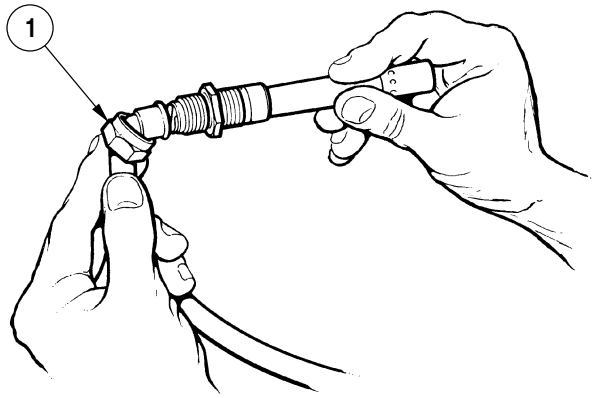
(2) Install one loop clamp assembly (6) on igniter cable assembly (7) or (12) and two loop clamp assemblies (6) onto igniter cable assembly (9).

(3) Position igniter cable assemblies (7) or (12) and (9) and loosely connect couplings (1) to connectors of ignition exciter unit (11) and to spark igniters (10).

(4) Secure loop clamp (6) on ignition cable assembly (7) or (12) to bracket (4) on elbow (5) with bolt (3) and self-locking nut (2). Torque nut to 36 to 40 lb.in.

NOTE: On JT15D-5 (Post-SB7207) and JT15D-5R engines, ensure bracket (4) is installed on outboard securing bolt of elbow (5).

(5) Secure one loop clamp on igniter cable (9) to T6 thermocouple harness connector support plate (8) and the other clamp to bracket on elbow (5) with bolts (3) and self-locking nuts (2). Torque nuts 36 to 40 lb.in.

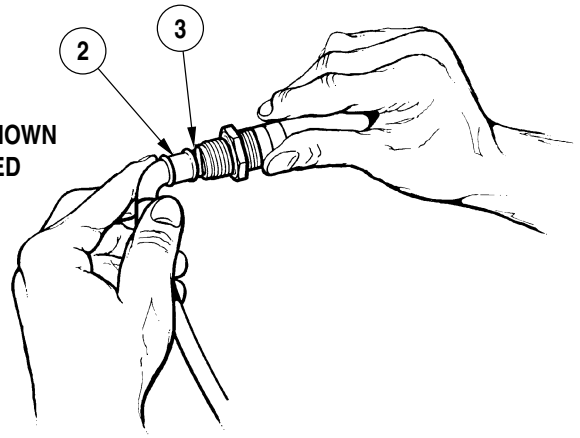


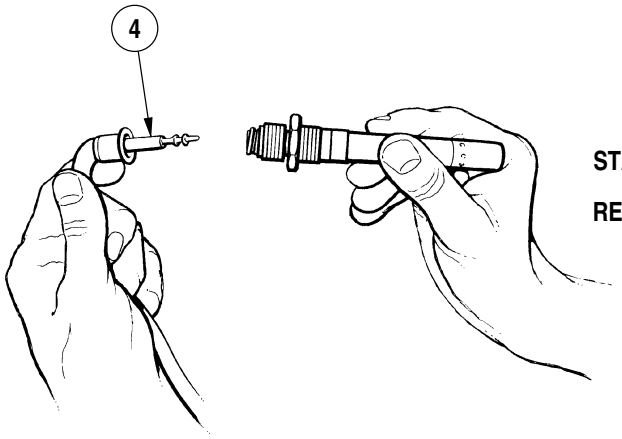
STAGE 1

REMOVE COUPLING NUT (ITEM 1)

STAGE 2

MANIPULATE CONDUITS ASSY (ITEM 2) AS SHOWN UNTIL SLEEVE (ITEM 3) BECOMES DISENGAGED





STAGE 3

REMOVE CONTACT SOCKET (ITEM 4) FROM SLEEVE

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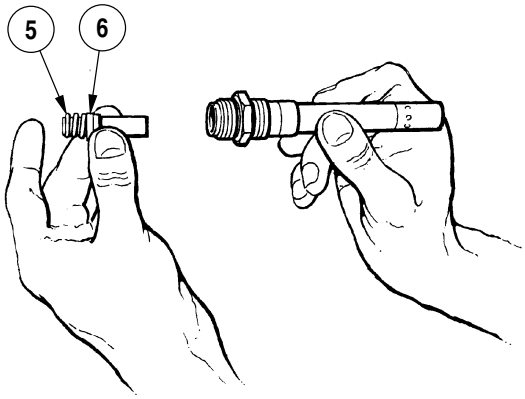
Removal of Igniter Cable Ends - JT15D-5 (Pre-SB7207)
Figure 202 (Sheet 1 of 2)

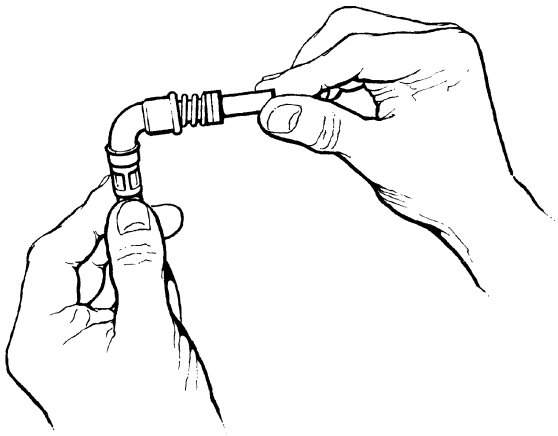


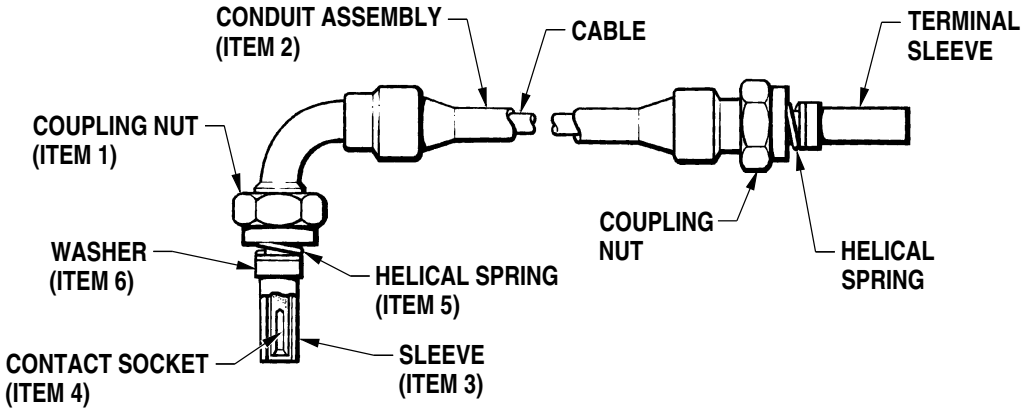
STAGE 4

REMOVE SLEEVE, HELICAL SPRING (ITEM 5) AND WASHER (ITEM 6)

STAGE 5

REINSTALL SLEEVE, HELICAL SPRING AND WASHER INTO CONDUIT ASSEMBLY





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Removal of Igniter Cable Ends - JT15D-5 (Pre-SB7207)
Figure 202 (Sheet 2)

(6) Tighten couplings at each end of igniter cable assemblies (7) or (12) and (9) 140 to 160 lb.in. and lockwire.

6. Inspection/Check

A. Procedure

(1) Check cables for chafing, cuts, abrasions or other damage.

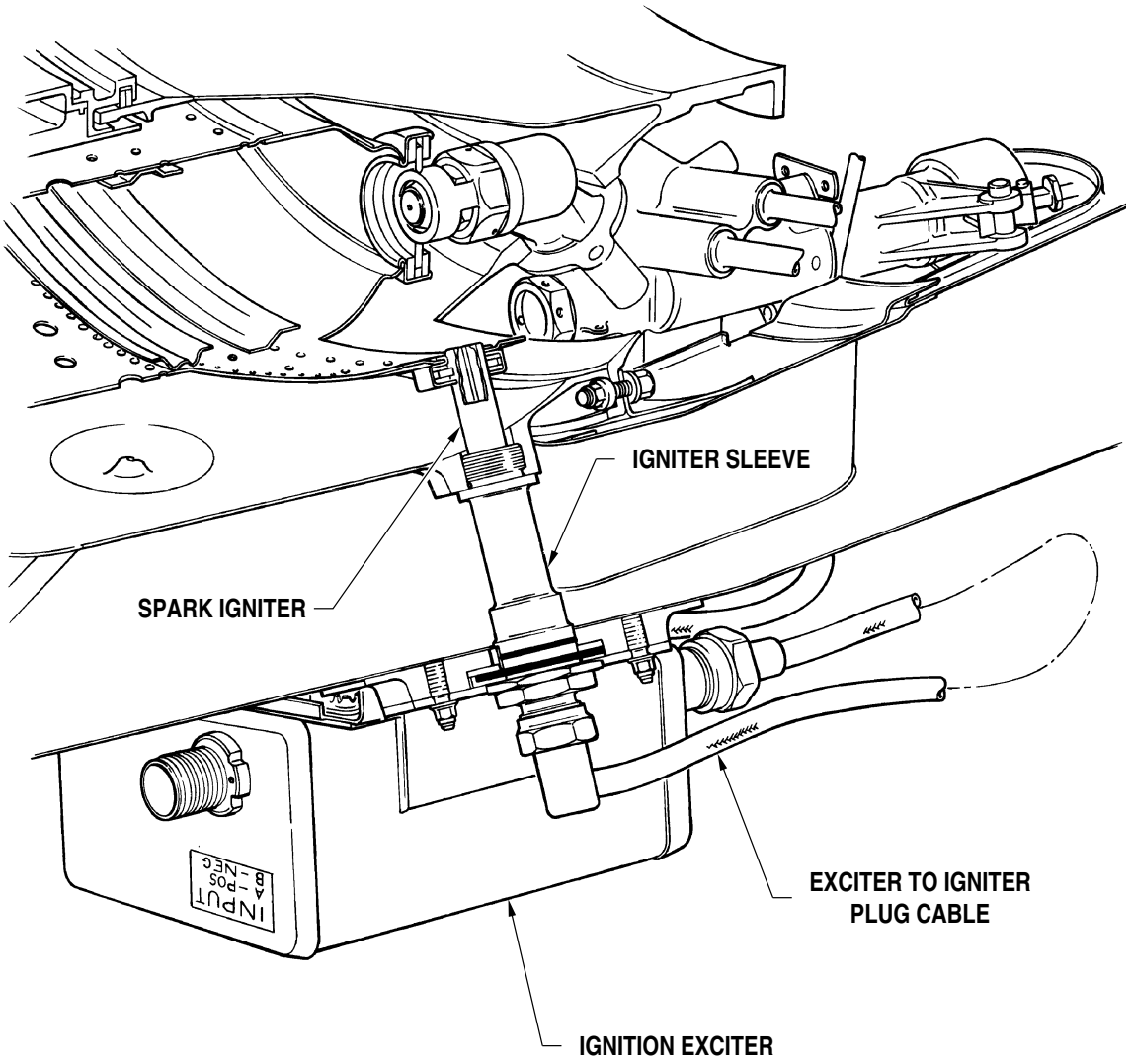
(2) Check cables for security of installation.

(3) Operationally check cables (Ref. 74-00-00).

SPARK IGNITERS - DESCRIPTION AND OPERATION

1. Spark Igniters (Ref. Fig. 1)

   Two spark igniters, positioned at 5 and 7 o'clock on the bypass duct respectively, are screwed through bosses on the gas generator case to locate in the floating washer igniter housings on the combustion chamber. The igniters are in the form of a threaded plug with a central positive electrode enclosed in an annular semi-conducting material. The electrical potential developed by the ignition exciter is applied across the gap between the central conductor and the igniter shell (ground). As this potential increases, a small current passes across the air gap. This current increases until the air between the central conductor and the shell ionizes. When ionization occurs, high energy discharges between the electrodes. The spark always occurs somewhere in the annular space between the central conductor and shell.



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Spark Igniter Installation (Typical)
Figure 1

SPARK IGNITERS - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the spark igniters.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC06-005	Dry Spray Lubricant
PWC11-010	Methyl Alcohol
PWC11-027	Petroleum Solvent

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal of Spark Igniters (Ref. Fig. 201)

      (1) Isolate power from ignition system.

      WARNING: VOLTAGE USED IN IGNITION SYSTEM IS DANGEROUSLY HIGH. BEFORE DISASSEMBLING ANY PART OF SYSTEM, SWITCH IGNITION OFF, DISCONNECT INPUT TO EXCITER AND ALLOW AT LEAST 6 MINUTES TO ELAPSE BEFORE FURTHER WORK. ALWAYS USE INSULATED TOOLS TO REMOVE COUPLING NUTS . DO NOT TOUCH OUTPUT CONNECTORS OR COUPLING NUTS WITH BARE HANDS.

      (2) Carefully disconnect coupling nuts (6) of igniter cable assemblies (1) or (8) and (2) from spark igniters (3).

      (3) Discharge any residual current in ignition exciter (7) by grounding both cable electrodes to spark igniter shields. Remove lockwire securing spark igniter (3) to sleeve (5).

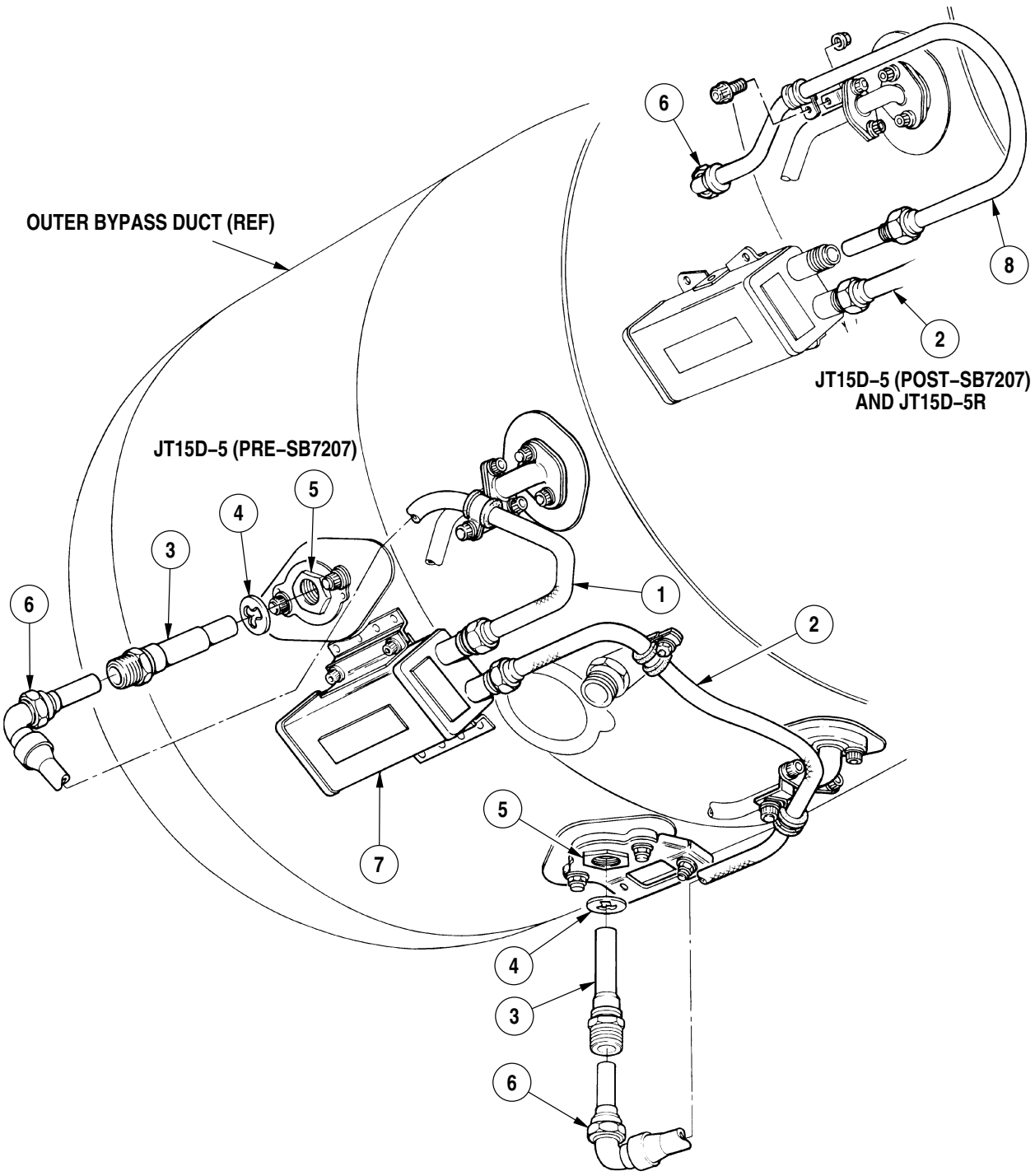
      (4) Loosen and remove spark igniters (3) and gaskets (4).

      (5) Remove and discard gasket (4) from each spark igniter (3).

   B. Installation of Spark Igniters (Ref. Fig. 201)

      CAUTION: IF A SPARK IGNITER IS DROPPED, UNDETECTABLE INTERNAL DAMAGE MAY OCCUR. REJECT DROPPED SPARK IGNITER.

      (1) Install new gasket (4) on each spark igniter.



Removal/Installation - Spark Igniters
Figure 201

Key to Figure 201

1. Igniter Cable Assembly (JT15D-5 Pre-SB7207)
2. Igniter Cable Assembly
3. Spark Igniters
4. Gasket
5. Sleeve (Bypass Duct)
6. Coupling
7. Ignition Exciter
8. Igniter Cable Assembly (JT15D-5 Post-SB7207 and JT15D-5R)

(2) Install spark igniters and gaskets into sleeves (5) at 5 and 7 o'clock positions on bypass duct.

NOTE: Ensure spark igniter properly engages the igniter seal in combustion chamber.

(3) Tighten and torque spark igniters to 300 lb.in. (REF. NO. 1714, Table 202).

NOTE: Spark igniter torque value is lower than igniter sleeve torque value to prevent sleeve being removed with spark igniter.

CAUTION: UNDER NO CIRCUMSTANCES IS LUBRICANT CONTAINING GREASE OR SILICONE, OR LUBRICANTS SUCH AS PETROLATUM, TO BE USED ON ANY IGNITION COMPONENT.

CAUTION: DO NOT ALLOW ANY LUBRICANT TO COME IN CONTACT WITH CENTRAL CONDUCTORS OF CABLES. SUCH CONTACT MAY RESULT IN A HIGH RESISTANCE PATH, POSSIBLY GENERATING HEAT AND OXIDATION.

CAUTION: DO NOT APPLY ANY LUBRICANT ON CABLES FEATURING TEFLON INSULATED SLEEVES.

(4) Using dry spray lubricant (PWC06-005), lightly spray rubber insulated ends of both ignition cables (1) and (2).

(5) Connect coupling nuts (6) of igniter cable assemblies (1) or (8) and (2) to spark igniter (3). Tighten nuts 140 to 160 lb.in. and lockwire.

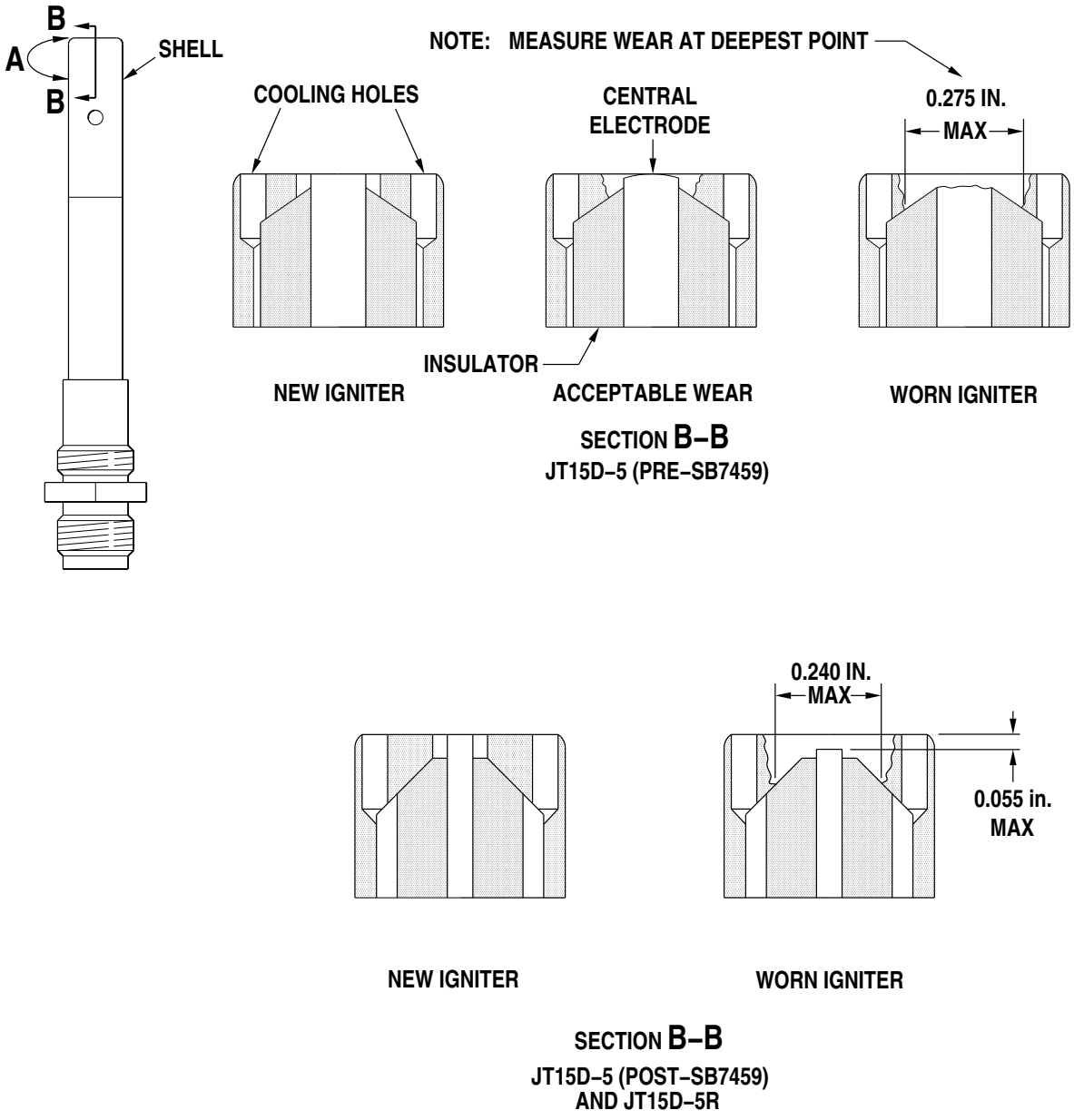
(6) Connect input cable to ignition exciter (7) (Ref. Airframe Maintenance Manual).

6. Inspection/Check

A. Spark Igniters (Ref. Fig. 202)

CAUTION: A DROPPED SPARK IGNITER MAY HAVE SUFFERED , UNDETECTABLE INTERNAL DAMAGE. REJECT DROPPED SPARK IGNITER.

(1) Clean spark igniter before inspection (Ref. Para. 7.).



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Spark Igniter Erosion Limits
Figure 202

(2) Inspect spark igniter outer shell Area A for chafing wear. Wear is allowable to a depth of 0.030 inch, over 360 degrees of shell circumference. Damage is unacceptable if resultant groove is over 0.030 inch deep for more than 120 degrees of the shell circumference or if the shell wall has been worn through.

(3) Check igniter shell and electrode for spark erosion . If erosion equals or exceeds amount shown on Figure 202, reject spark igniters.

(4) Operationally check spark igniter (Ref. Chapter 74-00-00, ADJUSTMENT/TEST).

7. Cleaning/Painting

A. Spark Igniters

CAUTION: DO NOT CLEAN THE NOSE (FIRING END) OF IGNITER.

(1) Do not remove carbon from electrodes or annular gap areas.

NOTE: Carbon deposits in the gap area are an aid to igniter operation.

(2) Observe all safety precautions with respect to high energy spark ignition systems before removing plugs from engine.

(3) Install a suitable cap over electrode end of igniter to prevent contamination by cleaning fluid.

(4) Using a felt swab, soaked in petroleum solvent (PWC11-027) or methyl alcohol (PWC11-010), clean inside of terminal well. Do not damage terminal pin during cleaning operation.

(5) Dry using clean, dry, filtered compressed air.

8. Fits and Clearances

A. Refer to Table 202 and Figure 203.

TABLE 201, Fits and Clearances

REF. NO.	Name	Dim. for Ref. (inches) Min.	Dim. for Ref. (inches) Max.	Limits (inches) Min.	Limits (inches) Max.	Limits (inches) Replace
Not Applicable						

TABLE 202, Torque and Stretch

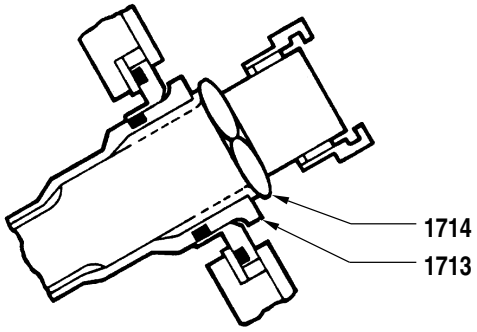
REF. NO.	Name	Limits Min.	Limits Max.
1713	Sleeve, Igniter	300	360
1714	Igniter	300	360

TABLE 203, Spring Pressure

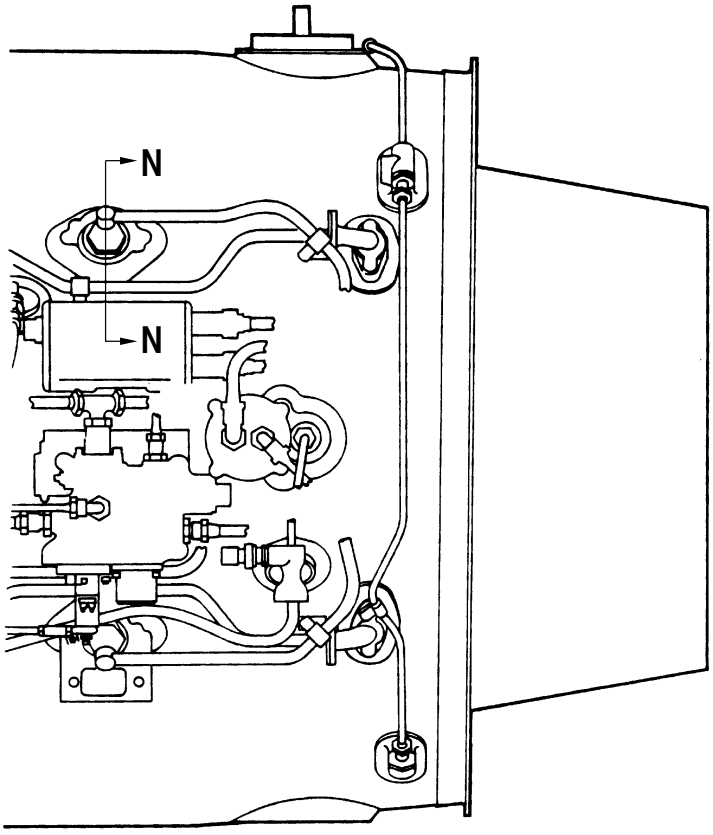
REF. NO.	Name	Limits Min.	Limits Max.
	Not Applicable		

TABLE 204, Special Assembly

REF. NO.	Name	Limits Min.	Limits Max.
	Not Applicable		



SECTION N–N



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Fits, Clearances and Torque Loadings
Figure 203

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
LEP	1	Feb 03/2014
	2 blank	Feb 03/2014
Contents	1	Feb 03/2014
	2	Feb 03/2014
75-00-00	1	Oct 06/2006
Description and	2	Oct 06/2006
Operation	3	Oct 06/2006
	4	Oct 06/2006
	5	Oct 06/2006
	6 blank	Oct 06/2006
75-00-00	101	Oct 22/99
Fault Isolation	102 blank	Oct 22/99
75-00-01	201	Oct 06/2006
Maintenance	202	Oct 06/2006
Practices	203	Oct 06/2006
	204	Oct 06/2006
	205	Oct 06/2006
	206	Oct 06/2006
75-00-02	201	Feb 03/2014
Maintenance	202	Feb 03/2014
Practices	203	Feb 03/2014
	204	Feb 03/2014
	205	Feb 03/2014
	206 blank	Feb 03/2014
75-00-03	201	Oct 22/99
Maintenance	202 blank	Oct 22/99
Practices		

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TABLE OF CONTENTS

SUBJECT	PAGE
AIR SYSTEMS - DESCRIPTION AND OPERATION	**75-00-00**
1. General	1
2. Description and Operation	1
A. Bearing Compartment Seals - Pressurizing Air	1
B. Turbine Disk and HP Turbine Stator Vanes - Cooling Air	1
C. Inlet Cone, LP Compressor Inner Stator and T1 Thermocouple Anti-icing - Hot Air	2
D. Fuel System and Aircraft Services	2
AIR SYSTEMS - FAULT ISOLATION	**75-00-00**
1. Fault Isolation	101
T1 THERMOCOUPLE ANTI-ICING AIR TUBE - MAINTENANCE PRACTICES	**75-00-01**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal of JT15D-5 Anti-icing Air Tube	201
B. Removal of JT15D-5R Anti-icing Air Tube	201
C. Installation of JT15D-5 Anti-icing Air Tube	203
D. Installation of JT15D-5R Anti-icing Air Tube	203
6. Inspection/Check	205
A. Inspect Anti-Icing Pressure Air Tube	205
LPC ANTI-ICING SOLENOID VALVE - MAINTENANCE PRACTICES	**75-00-02**
1. General	201
2. Consumable Materials	201
3. Special Tools	201

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TABLE OF CONTENTS

SUBJECT	PAGE
LPC ANTI-ICING SOLENOID VALVE - MAINTENANCE PRACTICES (Cont'd)	**75-00-02**
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal of Anti-icing Solenoid Valve and Tube	201
B. Installation of Anti-icing Solenoid Valve and Tube	203
6. Inspection/Check	204
A. Procedure	204
7. Approved Repairs	205
CABIN AIR BLEED - MAINTENANCE PRACTICES	**75-00-03**
1. General	201

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AIR SYSTEMS - DESCRIPTION AND OPERATION

1. General

HP compressor discharge air (P3) is bled off to provide pressurizing air for bearing compartment oil seals; cooling air for the turbine disks and the HP turbine stator vanes; and hot air for anti-icing protection of the inlet cone, the LP compressor inner stator ring and the T1 thermocouple probe. Additionally, bleed air from the HP compressor is provided for fuel system operation (Ref. Chapter 73) and for aircraft services.

2. Description and Operation (Ref. Figs. 1, 2 and 3)

A. Bearing Compartment Seals - Pressurizing Air

Oil is contained within the bearing compartments by bleeding air pressure through labyrinth seals toward each bearing. The labyrinth seals used on the engine consist of two separate parts: a labyrinth and a runner. Either part may rotate around or within the other, while in the case of No. 3-½ bearing, both parts rotate. The runners have plain circular surfaces, while the corresponding labyrinths have series of annular grooves machined in their inner or outer surfaces according to type. Each matched pair forms an air seal and controls the required pressure gradient.

The No.1 bearing has a front rotating labyrinth sealing system which ensures that air will always flow toward the bearing. The No. 2 bearing seal uses a rotating labyrinth located at the rear of the bearing. The No. 3 bearing has rotating labyrinths located at the front and rear of the bearing. The No. 3-½ bearing has outer rotating labyrinths and inner runners at the front and rear of the bearing. The No. 4 bearing has a rotating labyrinth at the front of the bearing. The air entering the bearing compartments is also used to assist the oil scavenge flow to the accessory gearbox from where it is vented to atmosphere through the centrifugal breather. The cavity formed within the intermediate case is sealed by the labyrinth seals at the front of the No. 1 bearing and the rear of the No. 2 bearing, therefore no seals are required at the rear of the No. 1 bearing and front of the No. 2 bearing. The No. 4 bearing compartment is sealed at the rear by the No. 4 bearing housing cover, so no labyrinth seal is required at the rear.

B. Turbine Disk and HP Turbine Stator Vanes - Cooling Air

Turbine disks are cooled by ducting compressor discharge air over the disk faces. The airflow to the high compressor turbine is controlled through single-stage seals over the balance rims. The airflow to the second-stage turbine and the front face of the third-stage turbine is controlled by stacked multistage seals, while the flow to the rear face of the third-stage turbine disk is controlled by the No. 4 bearing labyrinth seal.

The turbine disk cooling air is dispelled into the main gas stream. Compressor discharge air, passing through holes in the small exit duct assembly, enters the HP turbine stator vane liner inserts through the outer stator vane ring to cool the vanes. Venting slots in the trailing edge of each vane dispel the air into the gas stream.

C. Inlet Cone, LP Compressor Inner Stator and T1 Thermocouple Anti-icing - Hot Air

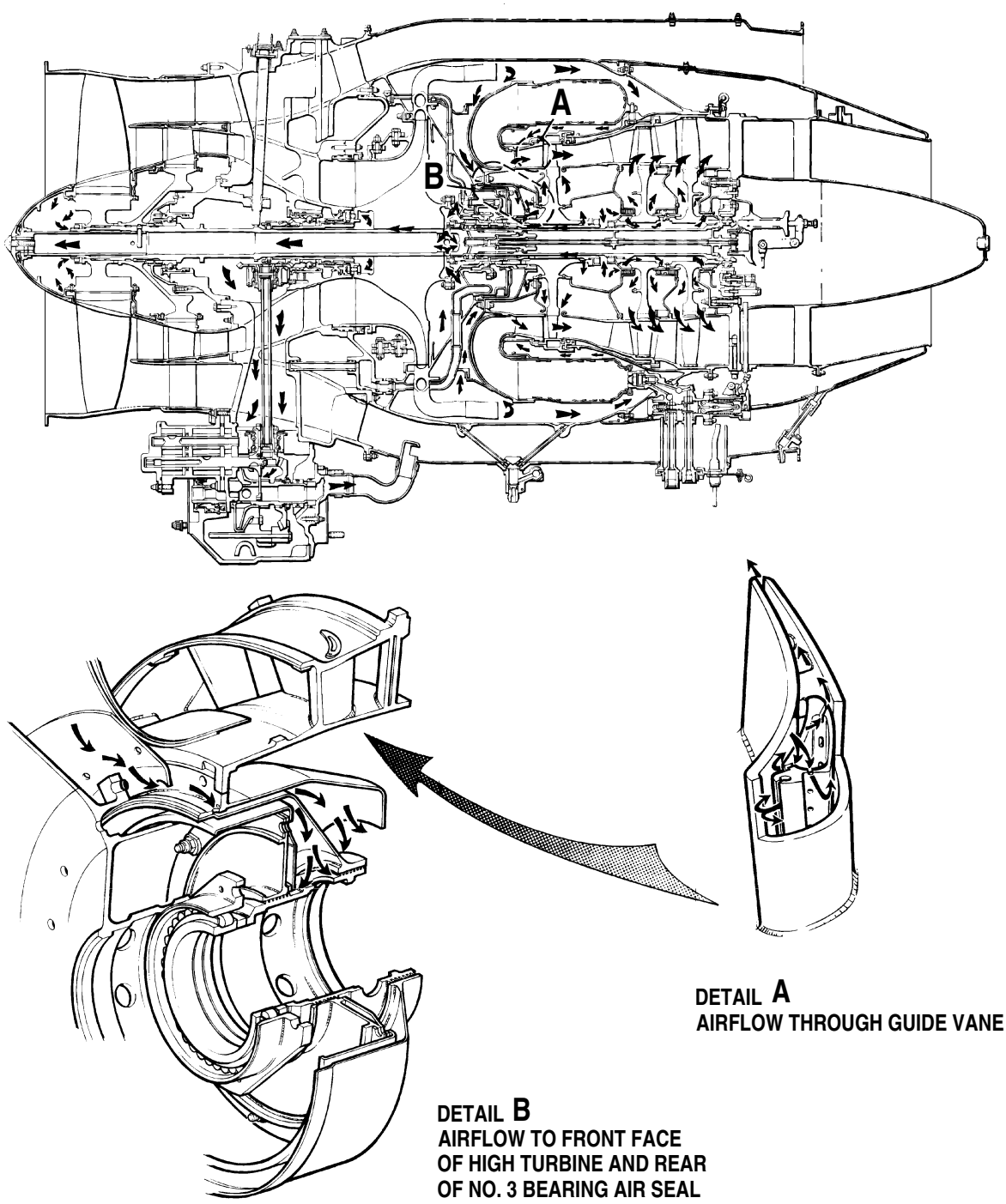
The inlet cone is heated by compressor discharge air, which is sent down the hollow LP compressor shaft. The double walled cone allows the air to pass rearward where it is discharged through holes in the inner wall, into the cone cavity. The air pressure in the cone cavity is routed to the No. 1 bearing labyrinth seal. A small part of the air, ducted through the LP compressor shaft, is discharged through the compressor inlet cone bolt. The LP compressor inner stator is heated by pressurized hot air ducted externally from the gas generator case through a tube assembly and solenoid shut-off valve to the intermediate case. The hot air passes through the outer strut at the 10 o'clock position to the inner bore of the intermediate case, where a channel leads it forward to the anti-icing air manifold. The air in the annular manifold passes through the two anti-icing air channels in each of the 52 front inner stator guide vanes, and is discharged around the leading rotary shroud to be absorbed by the primary air stream. The anti-icing solenoid valve is electrically connected to the engine electronic control to provide signals from compressor bleed air.

A transfer tube provides a path between the gas generator case and a boss on the bypass duct, located at the 4 o'clock position. Hot P3 air from the HP compressor is routed through an external tube, connected between the boss and an airframe inlet-mounted T1 thermocouple housing, to provide anti-icing protection for the thermocouple probe (Ref. Fig. 3).

D. Fuel System and Aircraft Services

The larger diameter external tube from the elbow on the bypass duct boss at the 4 o'clock position allows P3 air pressure to be routed for fuel control (HMU) governing and flow divider valve (FDV) spill valve operation.

Two pads, located on the outer bypass duct below the anti-icing and fuel control governing air pressure outlets at the 5 and 7 o'clock positions respectively, provide gas generator air bleed for aircraft services. Either or both of these outlets may be used.



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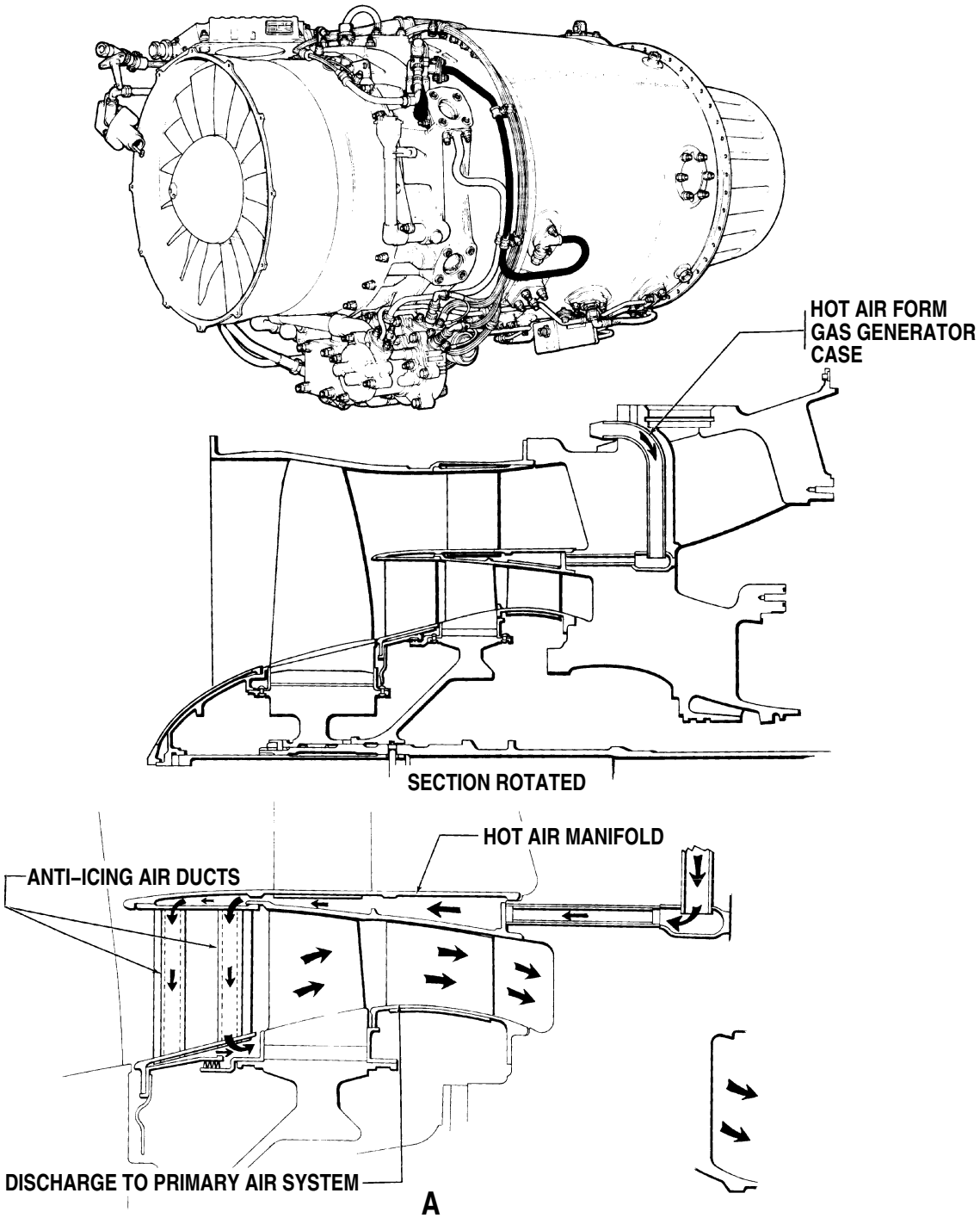
Engine Air Systems (Typical)
Figure 1



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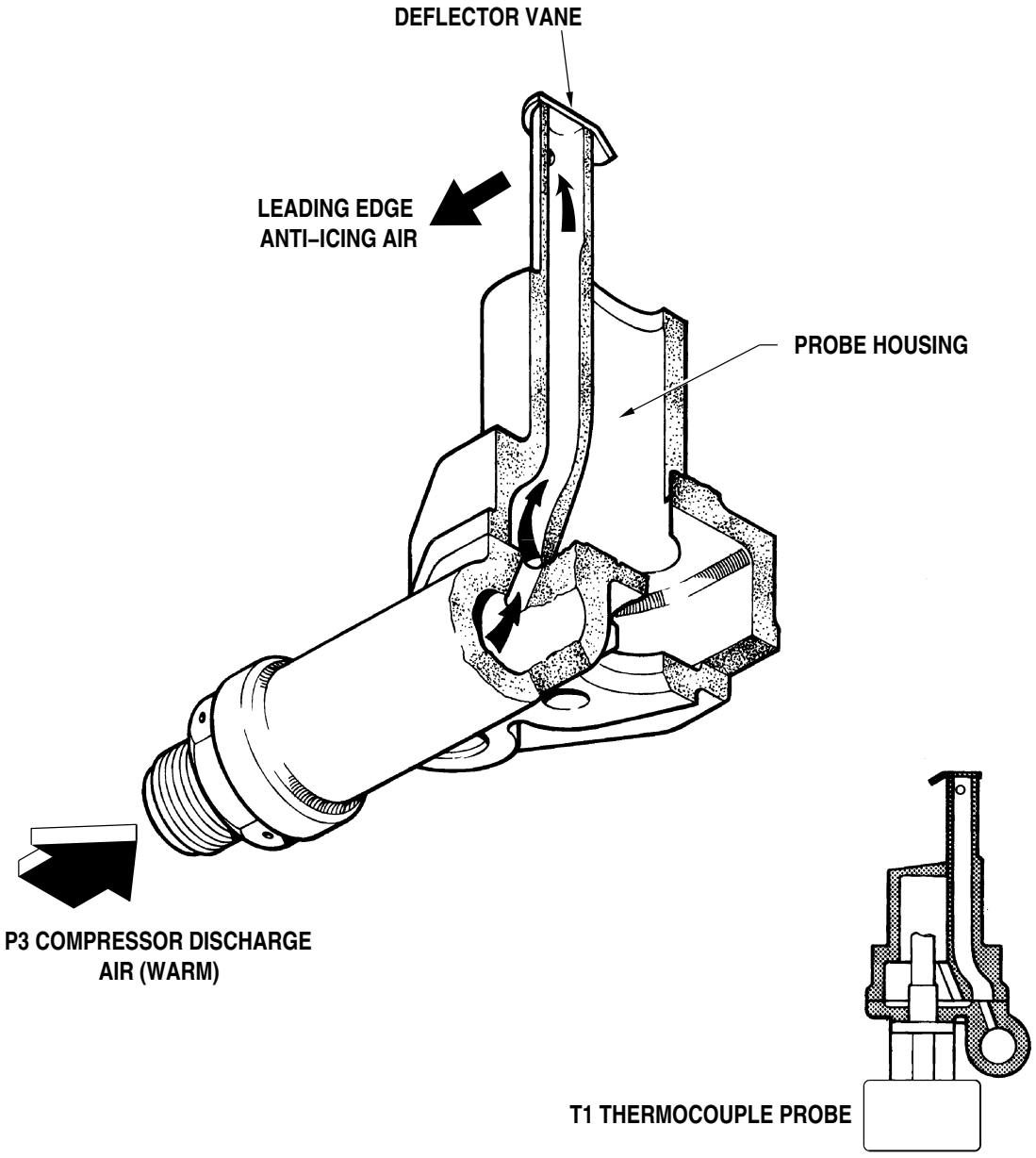
LP Compressor Inner Stator Anti-icing System (Typical)
Figure 2



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T1 Thermocouple Anti-icing
Figure 3

AIR SYSTEMS - FAULT ISOLATION

1. Fault Isolation

   For detailed fault isolation procedures for engine systems, refer to Chapter 72-00-00, FAULT ISOLATION, Tables 101 and 102.

T1 THERMOCOUPLE ANTI-ICING AIR TUBE - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the T1 thermocouple anti-icing air tube.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Engine Lubricating Oil
PWC05-061	Crocus Cloth

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal of JT15D-5 Anti-icing Air Tube (Ref. Fig. 201)

      (1) Remove bolts (3), self-locking nuts (4) and spacers (10) securing loop clamps on T1 anti-icing tube (8) to angle brackets and loop clamp assemblies on Flange A (Position B).

      (2) Remove self-locking nut (4), bolt (3) and sleeve spacer (10) securing two loop clamp assemblies (5) on intermediate case (Position C).

      (3) Remove self-locking nut (4) and bolt (3) securing one loop clamp assembly (5) to bracket (6)(Position D).

      (4) Remove self-locking nut (4) and bolt (3) securing loop clamp assembly (5) to bracket (7) (Position E).

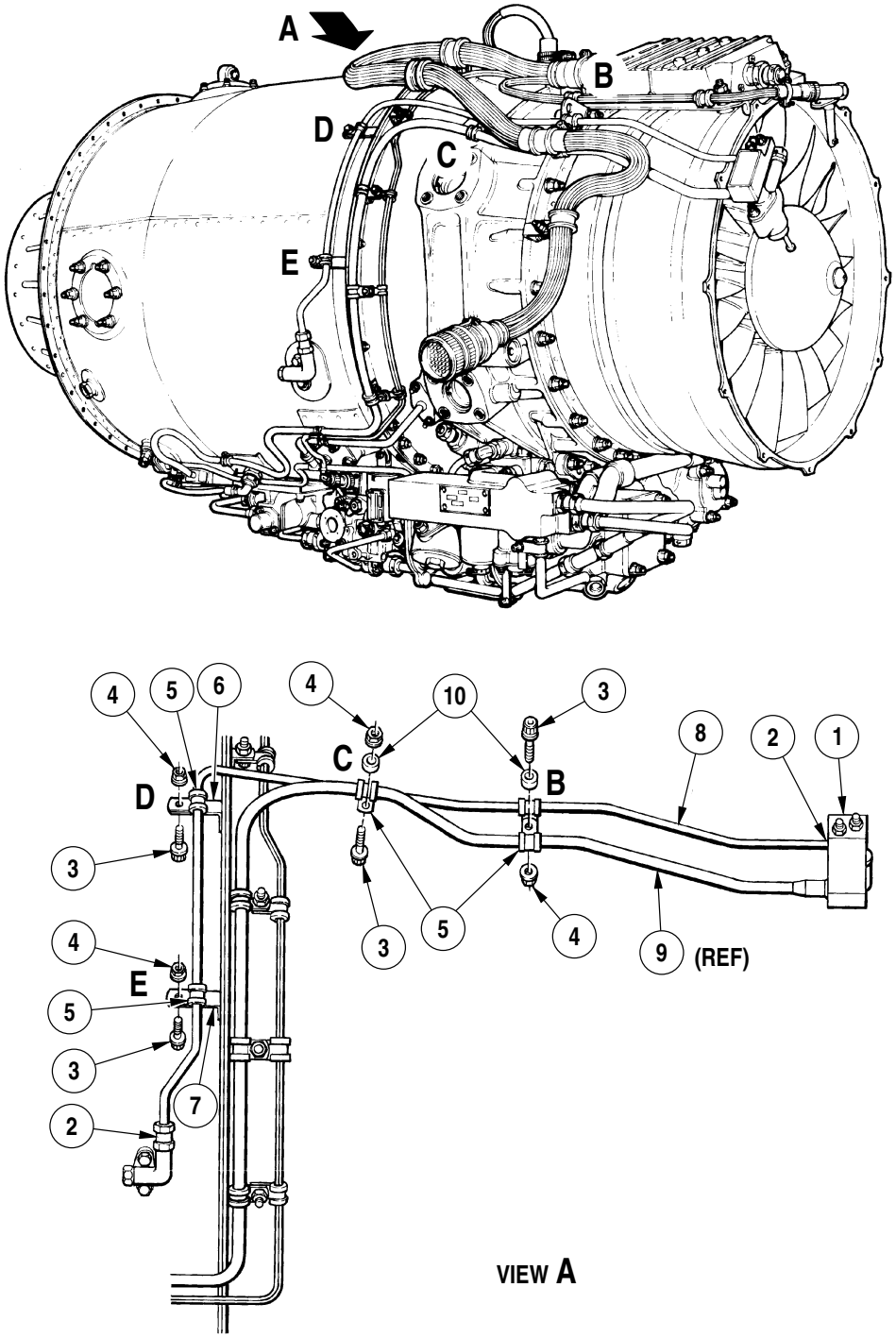
      (5) Disconnect coupling nuts at each end of anti-icing tube (8) and remove tube. Remove all unsecured loop clamp assemblies from anti-icing tube.

   B. Removal of JT15D-5R Anti-icing Air Tube (Ref. Fig. 202)

      (1) In two places, remove the nuts (5) and bolts (8) that attach the clamps (3) and (7) to the brackets (6).

      (2) Remove the nut (11), spacer (16), and bolt (12) that attach the clamps (10) and (14) to the clamp (9).

      (3) Remove the nut (20), bolt (17), and spacer (22) that attach the clamps (18), (19), and (23) to the bracket (21).



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Removal/Installation - T1 Thermocouple Anti-icing Air Tube
Figure 201

Key to Figure 201

1. T1 Thermocouple Housing
2. Anti-icing Tube Coupling Nut
3. Bolt
4. Self-locking Nut
5. Loop Clamp Assembly
6. Bracket
7. Bracket
8. Anti-icing Tube
9. T1 Thermocouple Harness (Ref.)
10. Sleeve Spacer

(4) Disconnect coupling nuts at each end of anti-icing tube (1) and remove tube.

(5) Put protective caps and covers in all openings.

C. Installation of JT15D-5 Anti-icing Air Tube (Ref. Fig. 201)

(1) At Positions B, C, D and E, install four loop clamp assemblies (5) on T1 anti-icing tube (8).

(2) Install tube (8) between elbow on T1 thermocouple housing (1) and elbow on bypass duct.

(3) Connect coupling nuts (2) at each end of anti-icing tube (8). Tighten and torque to 90 to 100 lb.in. and lockwire.

(4) Position E: secure one loop clamp (5) to angle bracket (7) on intermediate case at Flange B with bolt (3) and self-locking nut (4).

(5) Position D: secure one loop clamp (5) to angle bracket (6) on Flange B with bolt (3) and self-locking nut (4).

(6) Position C: secure two loop clamp assemblies (5) together with bolt (3), spacer (10) and self-locking nut (4).

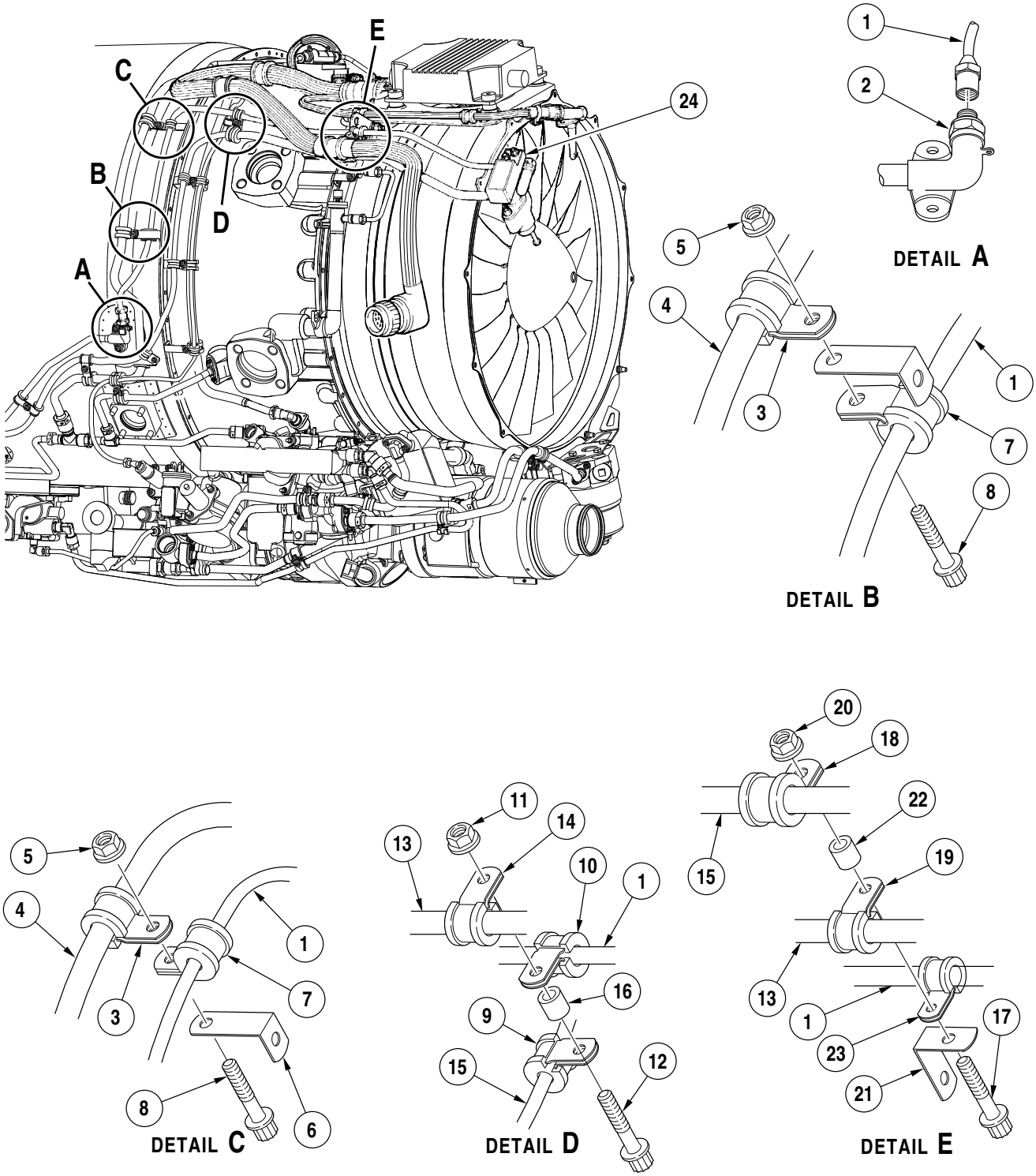
(7) Detail B: secure three loop clamp assemblies (5) to bracket on flange A with bolt (3), spacer (10) and self-locking nut (4).

(8) Tighten and torque nuts (4) securing loop clamps to 32 to 36 lb.in.

D. Installation of JT15D-5R Anti-icing Air Tube (Ref. Fig. 202)

(1) Remove the protective caps and covers from the openings.

(2) Connect the anti-icing air tube (1) to the nipple adapter (2) and the TI thermocouple housing (23).



JT15D-5R C109439

Removal/Installation - T1 Thermocouple Anti-icing Air Tube
Figure 202

Key to Figure 202

1. T1 Thermocouple Anti-icing Air Tube
2. Nipple Adapter
3. Clamp
4. Anti-Siphon Pressure Oil Tube (Ref.)
5. Self-Locking Nut
6. Bracket
7. Clamp
8. Bolt
9. Clamp
10. Clamp
11. Self-Locking Nut
12. Bolt
13. T1 Thermocouple Wiring Harness (Ref.)
14. Clamp
15. Electrical Wiring Harness (Ref.)
16. Spacer
17. Bolt
18. Clamp
19. Clamp
20. Self-Locking Nut
21. Bracket
22. Spacer
23. Clamp
24. T1 Thermocouple Housing

(3) Attach the clamps (18), (19), and (23to the bracket (21) with the spacer (22), bolt (17) and nut (20). Torque the nut 36 to 40 lbf.in.

(4) Attach the clamp (9) to the clamps (10) and (14) with the bolt (12), spacer (16) and nut (11). Torque the nut 36 to 40 lbf.in.

(5) In two places, attach the clamps (7) and (3) to the brackets (6) with the bolts (8) and the nuts (5). Torque the nut 36 to 40 lbf.in.

(6) Torque the anti-icing air tube (1) 70 to 80 lbf.in.

6. Inspection/Check

A. Inspect Anti-Icing Pressure Air Tube

(1) Scratches - Minor scratches having no appreciable depth are acceptable. Scratches to a depth of 0.005 inch should be blended out. Replace tube assembly if scratches exceed 0.005 inch deep.

(2) Nicks - Individual nicks up to 0.062 inch long by 0.010 inch wide and 0.003 inch deep are acceptable. Nicks to a maximum depth of 0.005 inch should be blended out to remove sharp edges.

(3) Dents - Round bottomed dents on straight sections of tubing are acceptable provided length and depth are not greater than 10 percent of outside diameter of tubing. No more than one dent, to maximum depth, per 12-inch length of tubing is acceptable. Dents on tube bends, which cause restriction by flattening and local weakening, are not acceptable.

(4) Pitting - Isolated minor pitting is acceptable provided pitting is not more than 0.003 inch deep. Clusters of pits not exceeding maximum depth of 0.005 inch should be blended out.

(5) Corrosion - Staining on tubing and surface corrosion is acceptable if removable by light polishing with crocus cloth (PWC05-061) and oil (PWC03-001).

LPC ANTI-ICING SOLENOID VALVE - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the LP compressor anti-icing solenoid valve and transfer tube.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Engine Lubricating Oil
PWC05-061	Crocus Cloth

3. Special Tools

   The special tools listed below are used in the following procedures.

Tool No.	Name
PWC30128-02	Puller

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal of Anti-icing Solenoid Valve and Tube (Ref. Fig. 201)

      (1) Remove two self-locking nuts (1) securing elbow boss on anti-icing tube (5) to bypass duct.

      (2) Disconnect harness connector (14) and remove from anti-icing valve (13). Protect and support harness (6).

      (3) Remove two self-locking nuts (1) and bolts (4) securing flanged end of anti-icing tube to anti-icing valve (13).

      (4) Remove self-locking nut (1) and bolt (9) securing loop clamp assemblies (7) and (8) at Position A. Collect spacer (18) and remove loop clamp assembly (7) from anti-icing tube.

      (5) Remove anti-icing tube assembly (5) and gaskets (2). Discard gaskets.

      (6) Using puller (PWC30128-02), remove transfer tube (11) from bypass duct. Remove and discard preformed packings (10).

      (7) Remove two self-locking nuts (1) securing anti-icing valve (13) to boss on intermediate case.

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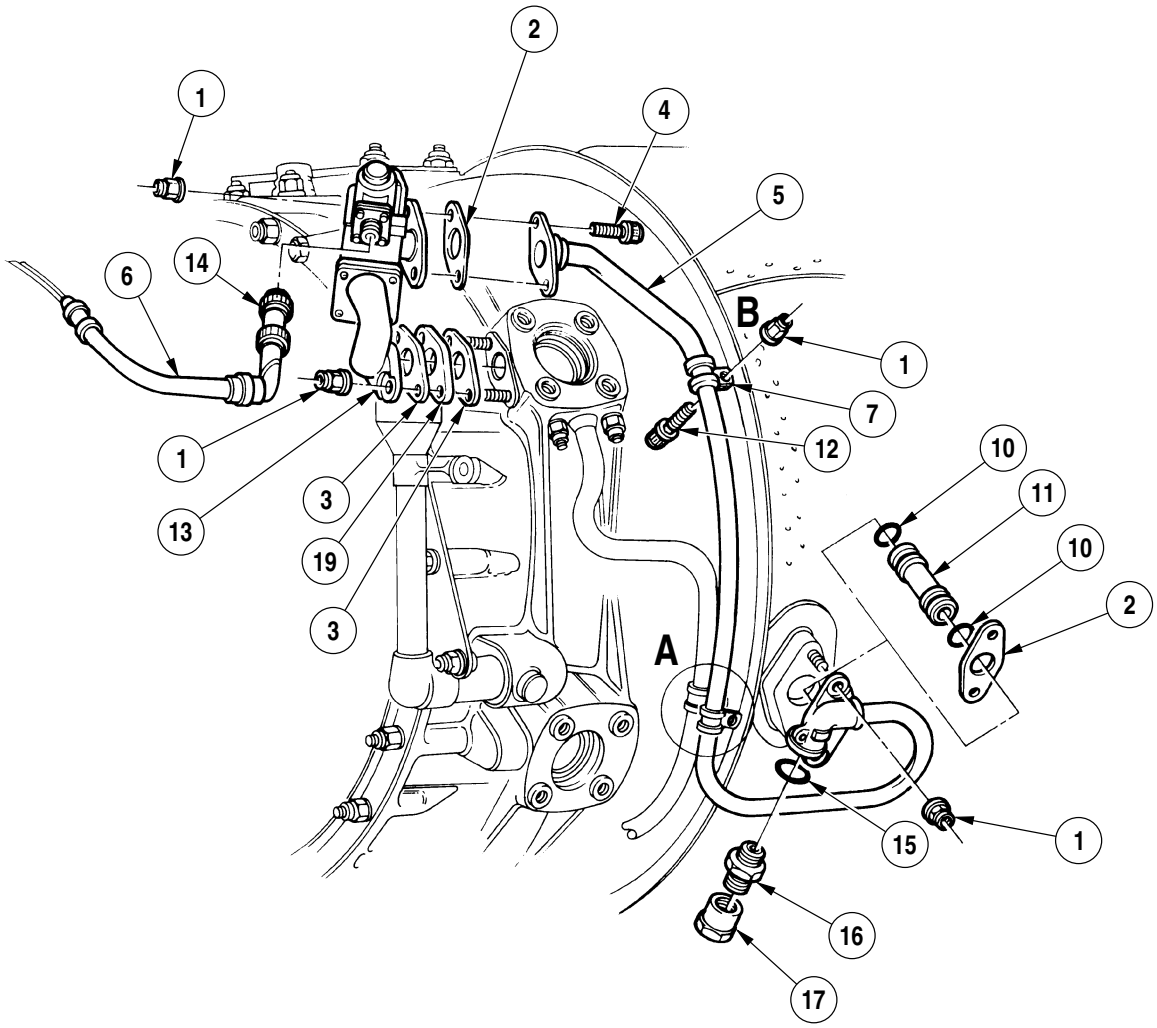

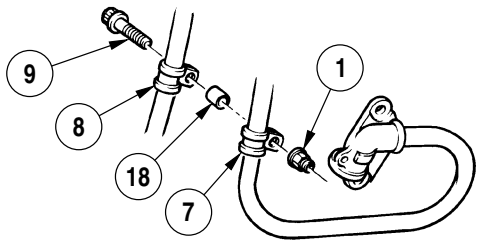

DETAIL A

C11506B

Removal/Installation - Anti-icing Tube and Valve
Figure 201

Key to Figure 201

1. Self-locking Nut
2. Gasket
3. Gasket (one for Pre-SB7211, two for Post-SB7211 and JT15D-5R)
4. Bolt
5. Anti-icing Tube Assembly
6. Engine Wiring Harness
7. Loop Clamp Assembly
8. Loop Clamp Assembly
9. Bolt
10. Preformed Packing
11. Transfer Tube
12. Bolt
13. Anti-icing Valve
14. Engine Wiring Harness Connector
15. Preformed Packing
16. Straight Nipple
17. Cap
18. Spacer
19. Spacer (Post-SB7211 engines and JT15D-5R only)

(a) JT15D-5 (Pre-SB7211) engines: remove valve and one gasket (3) from intermediate case. Discard gaskets.

(b) JT15D-5 (Post-SB7211) and JT15D-5R engines: remove valve, two gaskets (3) and spacer (19) from intermediate case. Discard gaskets.

B. Installation of Anti-icing Solenoid Valve and Tube (Ref. Fig. 201)

(1) Secure anti-icing valve (13):

(a) JT15D-5 (Pre-SB7211) engines: install spacer (19) between two gaskets (3) and anti-icing valve (13) on boss on intermediate case. Secure valve with two self-locking nuts (1). Tighten nuts and torque to 32 to 36 lb.in

(b) JT15D-5 (Post-SB7211) and JT15D-5R engines: install one gasket (3) and anti-icing valve (13) on boss on intermediate case. Secure with two self-locking nuts (1). Tighten nuts and torque to 32 to 36 lb.in.

(2) Install two new preformed packings (10) on transfer tube (11) and insert tube into boss on bypass duct.

(3) Position anti-icing tube assembly (5) and gasket (2) over studs of boss on bypass duct and secure with self-locking nuts (1). Torque nuts 32 to 36 lb.in.

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(4) Position anti-icing tube assembly (5) with new gasket (2) over studs of boss on bypass duct and secure with self-locking nuts (1). Torque nuts 32 to 36 lb.in.

(5) Secure other end of anti-icing tube assembly (5) with new gasket (2) to anti-icing valve (13), using two bolts (4) and self-locking nuts (1). Torque nuts 36 to 40 lb.in.

(6) Replace loop clamps as follows:

(a) Detail B: install loop clamp assembly (7) on anti-icing tube (5) and secure with bolt (12) and self-locking nut (1).

(b) Detail A: install loop clamp assembly (7) on anti-icing tube (5) and secure to loop clamp (8) with bolt (9), spacer (18) and self-locking nut (1).

(c) Check position and alignment of anti-icing tube and loop clamps. Tighten and torque self-locking nuts (1) 32 to 36lb.in.

(7) Secure harness connector (14) to anti-icing solenoid valve receptacle. Tighten handtight and lockwire.

(8) If required, install new preformed packing (15) on nipple (16) and install nipple in elbow on tube (5). Torque nipple 65 to 75 lb.in.

(9) Install cap (17) on nipple (16). Torque cap 90 to 100 lb.in. and lockwire.

6. Inspection/Check

A. Procedure

(1) Inspect anti-icing pressure air tubes as follows:

(a) Scratches - Minor scratches having no appreciable depth are acceptable. Scratches to a depth of 0.005 inch should be blended out. Replace tube assembly if scratches exceed 0.005 inch deep.

(b) Nicks - Individual nicks up to 0.062 inch long by 0.010 inch wide and 0.003 inch deep are acceptable. Nicks to a maximum depth of 0.005 inch should be blended out to remove sharp edges.

(c) Dents - Round bottomed dents on straight sections of tubing are acceptable provided length and depth are not greater than 10 percent of outside diameter of tubing. No more than one dent, to maximum depth, per 12-inch length of tubing is acceptable. Dents on tube bends, which cause restriction by flattening and local weakening, are not acceptable.

(d) Pitting - Isolated minor pitting is acceptable provided pitting is not more than 0.003 inch deep. Clusters of pits not exceeding maximum depth of 0.005 inch should be blended out.

(e) Corrosion - Staining on tubing and surface corrosion is acceptable, if removable by light polishing with crocus cloth (PWC05-061) and oil (PWC03-001).

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7. Approved Repairs

A. Repair anti-icing solenoid valve in accordance with procedures in South Bend Controls Solenoid Valve Assembly Component Maintenance Manual, P&WC P/N 3033624, Chapter 75-10-02.

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CABIN AIR BLEED - MAINTENANCE PRACTICES

1. General

Standard or non-standard air bleed tubes may be installed as required for a particular engine/aircraft installation. Removal/Installation of the air bleed tubes is not normally a maintenance requirement. Refer to Chapter 72-00-00, ENGINE: TURBINE - REMOVAL/INSTALLATION.

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
LEP	1	Apr 04/2016
	2 blank	Apr 04/2016
Contents	1	Apr 04/2016
	2	Apr 04/2016
77-00-00	1	Oct 22/99
Description and	2	Oct 22/99
Operation	3	Oct 22/99
	4 blank	Oct 22/99
77-00-00	101	Oct 22/99
Fault Isolation	102 blank	Oct 22/99
77-00-01	201	Apr 04/2016
Maintenance	202	Apr 04/2016
Practices	203	Apr 04/2016
	204	Apr 04/2016
	205	Apr 04/2016
	206	Apr 04/2016
	207	Apr 04/2016
	208	Apr 04/2016
	209	Apr 04/2016
	210	Apr 04/2016
	211	Apr 04/2016
	212	Apr 04/2016
	213	Apr 04/2016
	214	Apr 04/2016
77-00-02	201	May 13/2013
Maintenance	202	May 13/2013
Practices	203	May 13/2013
	204	May 13/2013
	205	May 13/2013
	206	May 13/2013
	207	May 13/2013
	208	May 13/2013
	209	May 13/2013
	210	May 13/2013
	211	May 13/2013
	212 blank	May 13/2013

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TABLE OF CONTENTS

SUBJECT	PAGE
ITT SENSING SYSTEM - DESCRIPTION AND OPERATION	**77-00-00**
1. General	1
2. Description)	1
A. T6 System	1
B. T1 System	1
3. Operation)	1
INTERTURBINE TEMPERATURE SENSING SYSTEM - FAULT ISOLATION	**77-00-00**
1. Fault Isolation	101
T1 THERMOCOUPLE WIRING HARNESS - MAINTENANCE PRACTICES	**77-00-01**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal of the JT15D-5 T1 Thermocouple Wiring Harness	201
B. Installation of the JT15D-5 T1 Thermocouple Wiring Harness	203
C. Removal of the JT15D-5R T1 Thermocouple Wiring Harness	204
D. Installation of the JT15D-5R T1 Thermocouple Wiring Harness	208
6. Adjustment/Test	209
A. T1 Thermocouple Harness Insulation, Resistance and Continuity Checks	209
B. Variable Resistor	210
7. Inspection/Check	210
A. T1 Thermocouple Harness	210
B. Variable Resistor	211

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The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
T6 WIRING HARNESS AND PROBES - MAINTENANCE PRACTICES	**77-00-02**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal of T6 Thermocouple Wiring Harness and Probes	201
B. Installation of T6 Thermocouple Wiring Harness and Probes	205
6. Adjustment/Test	206
A. T6 Thermocouple Harness Insulation, Resistance and Continuity Checks	206
7. Inspection/Check	207
A. T6 Thermocouple Harness	207
B. T6 Thermocouple Probes	207
C. T6 Thermocouple Heat Response Check	207
8. Approved Repairs	208
A. T6 Thermocouple Wiring Harness Repair	208
B. T6 Thermocouple Probes Repair	208

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ITT SENSING SYSTEM - DESCRIPTION AND OPERATION

1. General

The interturbine temperature (T5) sensing system provides the pilot with an indication of the engine operating temperature. The temperature sensing system consists of integrated T1 and T6 systems from which a simulated interturbine temperature (T5) readout is computed. The interturbine temperature measuring system is connected in parallel with a variable resistor externally mounted on the underside of the outer bypass duct at the 6 o'clock position.

2. Description (Ref. Fig. 1)

A. T6 System

The T6 system consists of an insulated wiring harness and six individual thermocouple probes connected in parallel to provide an average temperature reading. Harness branch leads connect each probe to a twin-lead output which provides connection to the T1 harness. For ease of identification, leads are color coded red for alumel and yellow for chromel. The thermocouple probes are secured to the exhaust duct and, when installed on the engine, the probes protrude into the gas path from cutouts in leading edges of the exhaust duct nozzle struts. The wiring harness is positioned around the forward flange of exhaust duct, at Flange C.

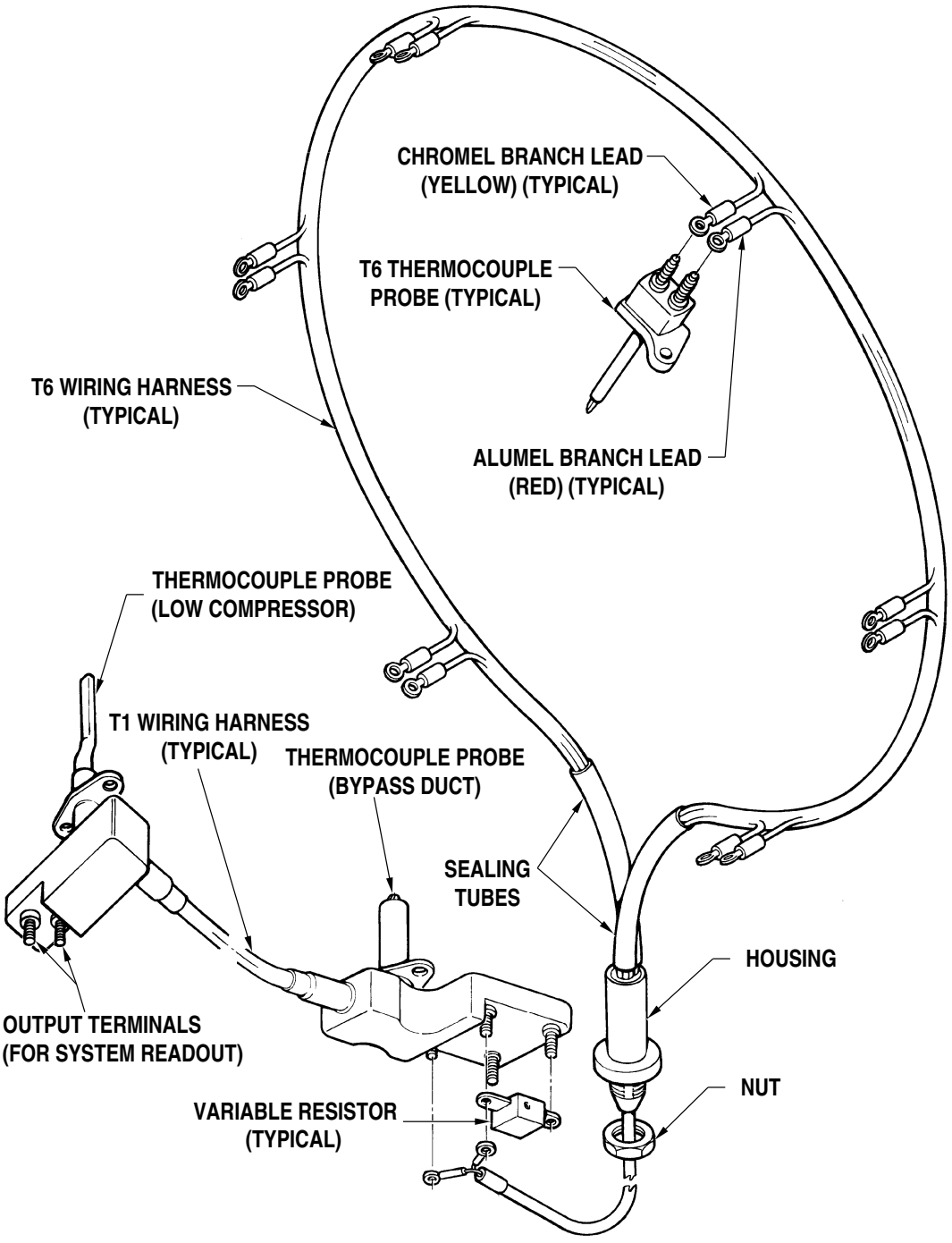
B. T1 System

The T1 system consists of a braided wiring harness with two temperature probes, each incorporating three thermocouples. When installed on the engine, one probe protrudes into the inlet air stream in the low pressure compressor case and the other protrudes into the bypass air flow through the rear of the bypass duct. The six thermocouples are connected in series through the harness to provide a readout equivalent to three times the temperature rise through the bypass air stream. A variable resistor, connected to the wiring harness via mutual installation on the bypass duct probe body, is adjusted during final acceptance tests of the engine to standardize T5 readout range. The T6 system and variable resistor are connected to the T1 system via terminal studs on the bypass duct probe body. To provide an airframe connection for the system output signal, the low pressure compressor probe body has two terminal studs.

3. Operation (Ref. Fig. 2)

A simulated interturbine temperature (T5) readout is computed by adding three times the air temperature rise across the bypass duct to the exhaust temperature and standardizing this temperature range through a variable resistor.

By sensing the inlet and outlet temperatures of the bypass air stream, the rise in air temperature through the bypass duct can be established by subtracting inlet from outlet temperature. This is accomplished via the T1 probes and, as each probe contains three thermocouples connected in series, the rise in temperature is multiplied by three to provide the required readout. The T6 thermocouple probes are connected in parallel through the wiring harness to provide an average exhaust temperature and, with the T6 and T1 harnesses connected in series, a total readout of T6 plus three times the rise in bypass air temperature is provided as the output signal.



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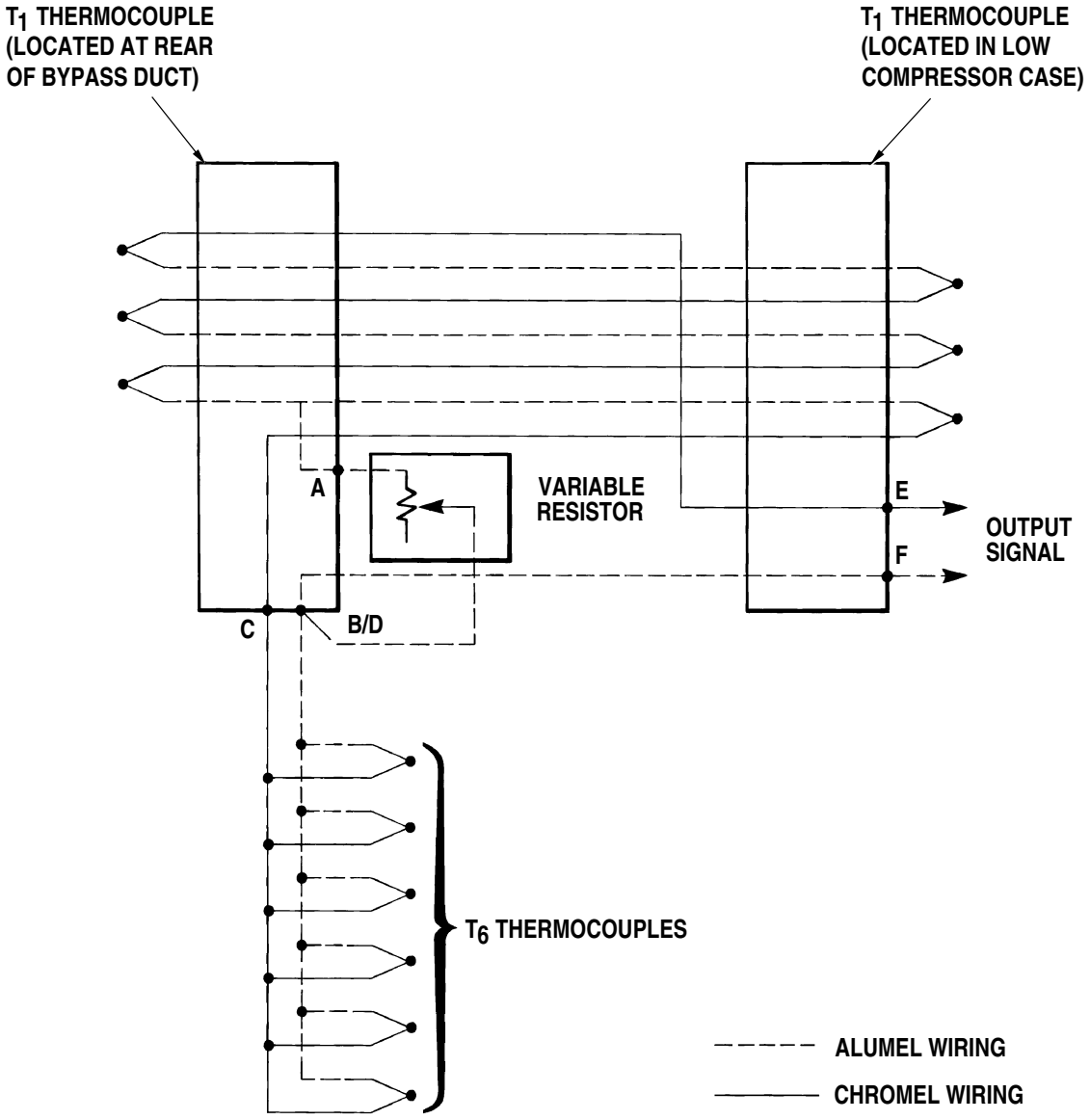
Temperature Sensing System (Typical)
Figure 1



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Temperature Sensing System Wiring Diagram (Typical)
Figure 2

INTERTURBINE TEMPERATURE SENSING SYSTEM - FAULT ISOLATION

1. Fault Isolation

   For detailed fault isolation procedure on engine system, refer to Chapter 72-00-00, FAULT ISOLATION, Fault Isolation for Engine Operating Problems.

T1 THERMOCOUPLE WIRING HARNESS - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the T1 thermocouple wiring harness.

2. Consumable Materials

   Not Applicable

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   The fixtures, equipment and supplier tools listed below are referred to in procedural text.

Name	Remarks
Test Set, Resistance and Continuity Checks	2312G or TT-1000A

5. Removal/Installation

   A. Removal of the JT15D-5 T1 Thermocouple Wiring Harness (Ref. Fig. 201)

      (1) Remove two self-locking nuts (8) and (9) and disconnect airframe cable terminals from T1 thermocouple probe fitting (11) at upper right-hand side of airframe intake duct.

      (2) Disconnect T1 anti-icing tube (22) coupling nut from T1 thermocouple (11) (Ref. 75-00-01).

      (3) Remove two bolts (10) securing T1 thermocouple probe fitting (11) to airframe (Ref. Airframe Maintenance Manual).

      (4) Remove self-locking nut and bolt securing T1 thermocouple harness (1) loop clamp assembly (5), engine control harness (12) loop clamp assembly and anti-icing tube (22) loop clamp assembly (6) to angle bracket at flange A.

      (5) Remove seven self-locking nuts (3), six bolts (4) and one bolt (2) at Locations A through G.

      (6) Remove seven loop clamp assemblies at positions which secure T1 harness to flange A, anti-icing tube, P3 tube and brackets at flange B. Collect spacers (7) from Positions A and G.

         NOTE: Take note of harness routing, all clamp positions and particularly, spacer locations to facilitate reinstallation.

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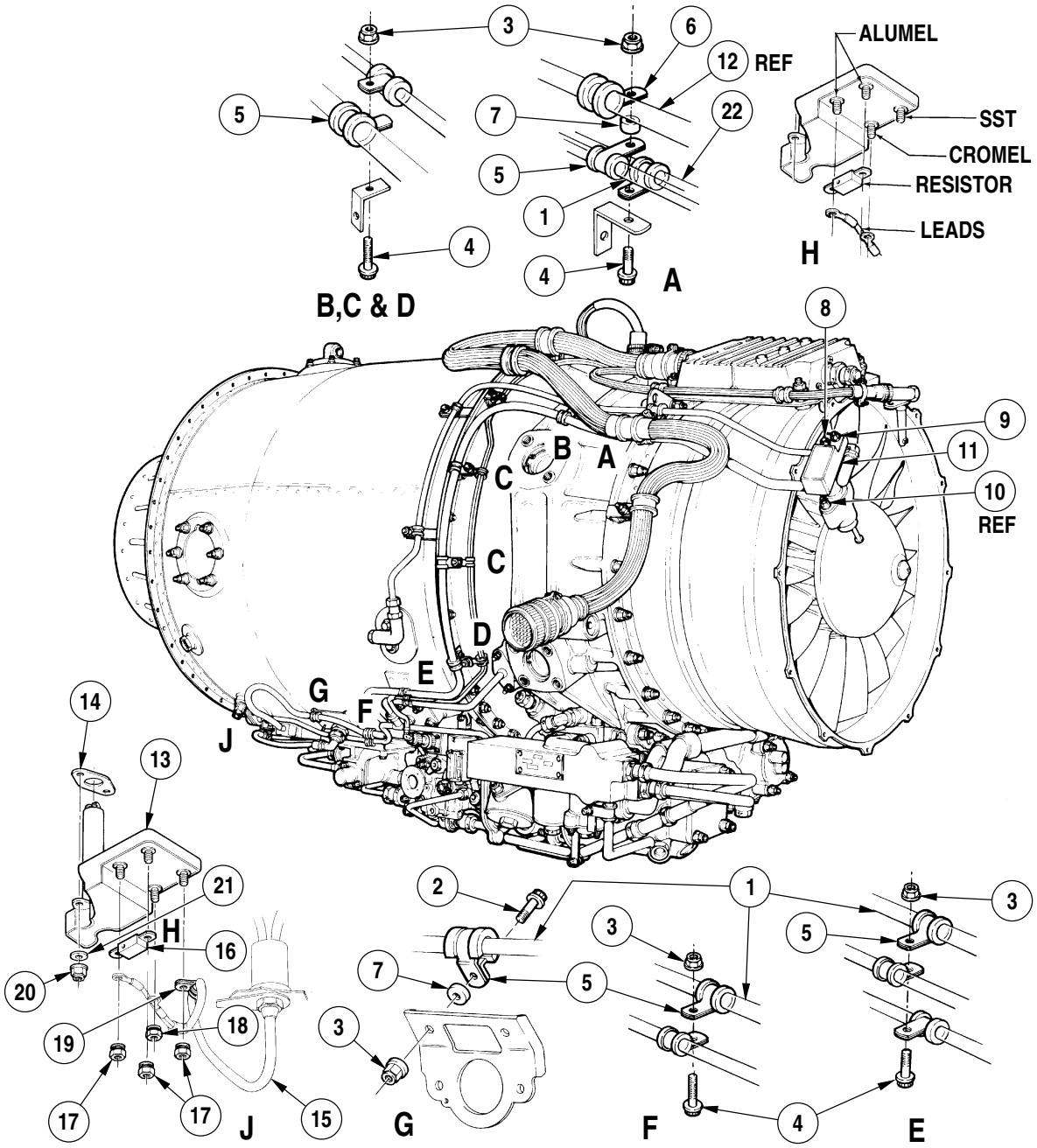

JT15D-5 C11542

Removal/Installation - T1 Thermocouple Wiring Harness
Figure 201

Key to Figure 201

1. T1 Thermocouple Harness
2. Bolt
3. Self-locking Nut
4. Bolt
5. Loop Clamp Assembly
6. Loop Clamp Assembly
7. Spacer
8. Self-locking Nut (Chromel)
9. Self-locking Nut (Alumel)
10. Bolt (Aircraft Part, shown for ref. only)
11. T1 Thermocouple
12. Control Harness
13. T1 Probe Junction Fitting
14. Gasket
15. T6 Harness
16. Variable Resistor
17. Self-locking Nut (Alumel)
18. Self-locking Nut (Chromel)
19. Loop Clamp Assembly (T6 Harness)
20. Self-locking Nut
21. Washer
22. T1 Thermocouple Anti-icing Air Tube

(7) Remove three alumel self-locking nuts (17) and one chromel self-locking nut (18) securing T6 harness (15) terminals and variable resistor (16) to T1 probe/junction fitting (13).

(8) Detach T6 harness terminals and loop clamp assembly (19) from studs, then remove variable resistor (16).

(9) Keep variable resistor (16) with T1 harness unless a replacement harness is to be installed, in which case, the resistor must be transferred.

(10) Remove two self-locking nuts (20) and washers (21) securing T1 probe/junction fitting (13) to bypass duct. Remove T1 harness (1) and gasket (14). Discard gasket. Store harness with attaching parts in a suitable container.

B. Installation of the JT15D-5 T1 Thermocouple Wiring Harness (Ref. Fig. 201)

(1) Position gasket (14) on bypass duct at 5 o'clock position. Insert T1 harness probe/junction (13) and secure with two washers (21) and two self-locking nuts (20). Tighten nuts and torque to 32 to 36 lb.in.

(2) Install front T1 thermocouple probe (11) into housing at upper right-hand side of aircraft intake duct (Ref. Airframe Maintenance Manual).

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(3) Install eight loop clamp assemblies (5) on T1 thermocouple harness (1) at Locations A through G:

(a) Location A: secure loop clamp assemblies (5) and (6), spacer (7) and loop clamp on anti-icing tube (22) to flange bracket with bolt (4) and self-locking nut (3). Tighten and torque nut 32 to 36 lb.in

(b) Locations B,C,D: secure T1 thermocouple harness loop clamp assemblies (5) and loop clamps on engine wiring harness to angle brackets with bolts (4) and self-locking nuts (3). Torque nuts 32 to 36 lb.in.

(c) Location F: secure two loop clamp assemblies with bolt (4) and self-locking nut (3). Torque nut 32 to 36 lb.in.

(d) Location G: Secure loop clamp (5) and spacer (7) to bracket with bolt (4) and self-locking nut (3). Torque nut 32 to 36 lb.in.

(4) Install T1 anti-icing tube (22) on T1 thermocouple probe housing (Ref. 75-00-01).

(5) Location J: install variable resistor (16) on two larger front studs of T1 probe/junction (13). Ensure variable resistor adjuster recess is facing forward. Install larger diameter T6 terminal (alumel) on front right-hand stud of probe/junction and small diameter T6 terminal (chromel) on opposite smaller diameter stud (refer to View S) as follows:

(a) Secure terminals and variable resistor (16) with self-locking nuts (17) and (18) . Tighten and torque nuts (17) for alumel terminals to 24 to 40 lb.in., and nut (18) for chromel terminal to 15 to 20 lb.in.

(b) Install T6 harness loop clamp (19) on remaining rear stud of probe/junction and secure with self-locking nut (17). Tighten and torque nut to 24 to 40 lb.in.

(6) Connect airframe cable terminals to studs on T1 thermocouple probe and secure with self-locking nuts (8) and (9). Torque nut (8) for chromel terminal to 15 to 20 lb.in. and nut (9) for alumel terminal to 24 to 40 lb.in.

C. Removal of the JT15D-5R T1 Thermocouple Wiring Harness (Ref. Fig. 202)

NOTE: After removal, keep the clamps with the applicable harness or tube. If you replace the harness, transfer the clamps to the new harness.

(1) Remove two self-locking nuts (56) and (57) and disconnect airframe cable terminals from T1 thermocouple probe fitting at upper right-hand side of airframe intake duct.

(2) Disconnect T1 anti-icing tube coupling nut from T1 thermocouple (Ref. 75-00-01).

(3) Remove two bolts (59) securing T1 thermocouple probe fitting to airframe (Ref. Airframe Maintenance Manual).

(4) Remove three alumel self-locking nuts (7) and one chromel self-locking nut (6) securing T6 harness (8) terminals and variable resistor (5) to T1 probe/junction fitting (1).

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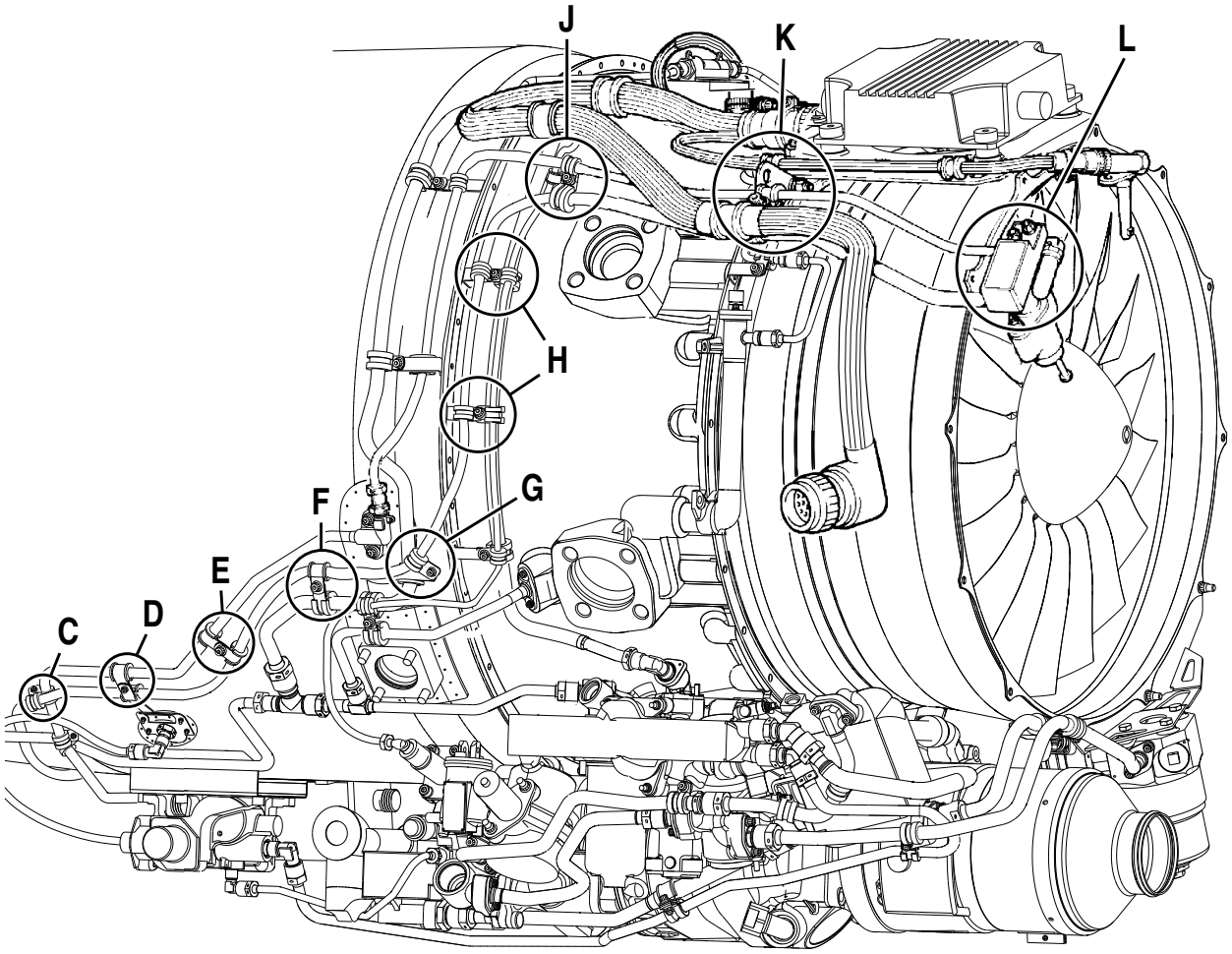
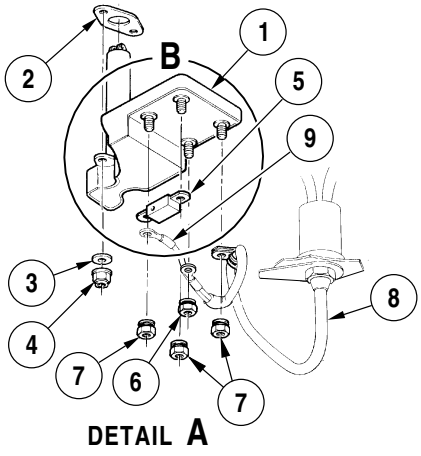
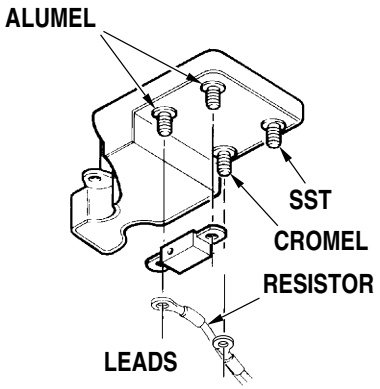
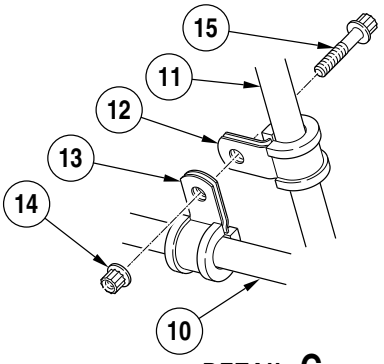




DETAIL A



DETAIL B



DETAIL C

JT15D-5R

C109508

Removal/Installation - T1 Thermocouple Wiring Harness
Figure 202 (Sheet 1 of 2)

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Key to Figure 202

1. T1 Probe Junction Fitting
2. Gasket
3. Washer
4. Self-locking Nut
5. Variable Resistor
6. Self-locking Nut (Chromel)
7. Self-locking Nut (Alumel)
8. T6 Harness
9. Loop Clamp Assembly (T6 Harness)
10. T1 Thermocouple Wiring Harness
11. P3 Delivery Tube (FDV)
12. Loop Clamp Assembly
13. Loop Clamp Assembly
14. Self-locking Nut
15. Bolt
16. Loop Clamp Assembly
17. Loop Clamp Assembly
18. Bracket
19. Bolt
20. Self-locking Nut
21. Bolt
22. Loop Clamp Assembly
23. Loop Clamp Assembly
24. Self-locking Nut
25. Anti-Siphon Pressure Oil Tube (Ref.)
26. Loop Clamp Assembly
27. Loop Clamp Assembly
28. Bolt
29. Self-locking Nut
30. Anti-Siphon Pressure Oil Tube (Ref.)
31. Loop Clamp Assembly
32. Self-locking Nut
33. Bolt
34. Loop Clamp Assembly
35. Loop Clamp Assembly
36. Loop Clamp Assembly
37. Loop Clamp Assembly
38. Bolt
39. Self-locking Nut
40. Electrical Wiring Harness (Ref.)
41. Bracket
42. T1 thermocouple Anti-Icing Air Tube
43. Loop Clamp Assembly
44. Loop Clamp Assembly
45. Loop Clamp Assembly
46. Self-locking Nut
47. Bolt
48. Spacer
49. Loop Clamp Assembly
50. Loop Clamp Assembly
51. Self-locking Nut
52. Bracket
53. Spacer
55. Loop Clamp Assembly
56. Self-locking Nut (Chromel)
57. Self-locking Nut (Alumel)
58. T1 Thermocouple
59. Bolt (Aircraft Part, shown for ref. only)

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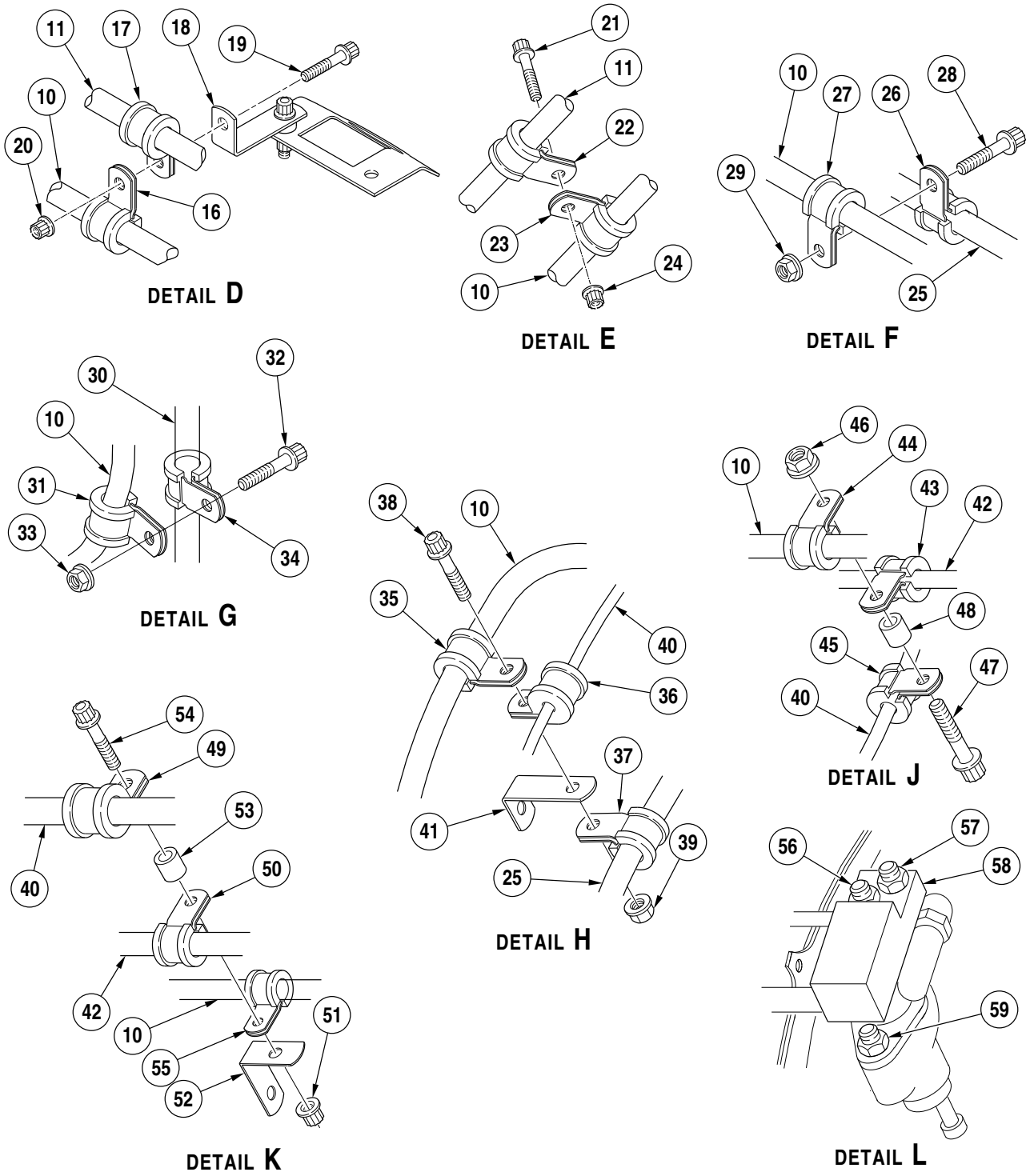

JT15D-5R C109509

Removal/Installation - T1 Thermocouple Wiring Harness
Figure 202 (Sheet 2)

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(5) Detach T6 harness terminals and loop clamp assembly (9) from studs, then remove variable resistor (5).

(6) Keep variable resistor (5) with T1 harness unless a replacement harness is to be installed, in which case, the resistor must be transferred.

(7) Remove two self-locking nuts (4) and washers (3) securing T1 probe/junction fitting (1) to bypass duct. Remove T1 harness (1) and gasket (2). Discard gasket. Store harness with attaching parts in a suitable container.

(8) Remove the nut (14) and bolt (15) that attach the clamp (12) to the clamp (13).

(9) Remove the nut (20) and bolt (17) that attach the clamps (16) and (17) to the bracket (18).

(10) Remove the nut (24) and bolt (21) that attach the clamp (22) to the clamp (23).

(11) Remove the nut (29) and bolt (28) that attach the clamp (26) to the clamp (27).

(12) Remove the nut (32) and bolt (33) that attach the clamp (31) to the clamp (34).

(13) In two places, remove the nuts (39) and bolts (38) that attach the clamps (36) and (37) to the clamp (35).

(14) Remove the nut (46), spacer (48), and bolt (47) that attach the clamps (43) and (44) to the clamp (45).

(15) Remove the nut (51), spacer (53), and bolt (54) that attach the clamps (49), (50), and (55) to the bracket (52).

(16) Install protective caps and covers on all openings and electrical connectors.

D. Installation of the JT15D-5R T1 Thermocouple Wiring Harness (Ref. Fig. 202)

(1) Remove the protective caps and covers.

(2) Connect airframe cable terminals to studs on T1 thermocouple probe and secure with self-locking nuts (56) and (57). Torque nut (56) for chromel terminal to 15 to 20 lb.in. and nut (57) for alumel terminal to 24 to 40 lb.in.

(3) Attach the clamps (49), (50), and (55) to the bracket (52) with the bolt (54), spacer (53), and nut (51). Torque the nut 36 to 40 lbf.in.

(4) Attach the clamp (45) to the clamps (43) and (44) with the bolt (47), spacer (48) and nut (46). Torque the nut 36 to 40 lbf.in.

(5) In two places, attach the clamps (35) to the clamps (36) and (37) with the bolts (38) and nuts (39). Torque the nuts 36 to 40 lbf.in.

(6) Attach the clamp (31) to the clamp (34) with the bolt (33) and nut (32). Torque the nut 36 to 40 lbf.in.

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(7) Attach the clamp (26) to the clamp (27) with the bolt (28) and nut (29). Torque the nut 36 to 40 lbf.in.

(8) Attach the clamp (22) to the clamp (23) with the bolt (21) and nut (24). Torque the nut 36 to 40 lbf.in.

(9) Attach the clamps (16) and (17) to the bracket (18) with the bolt (19) and nut (20). Torque the nut 36 to 40 lbf.in.

(10) Attach the clamp (12) to the clamp (13) with the bolt (15) and nut (14). Torque the nut 36 to 40 lbf.in.

(11) Install variable resistor (5) on two larger front studs of T1 probe/junction (1). Ensure variable resistor adjuster recess is facing forward. Install larger diameter T6 terminal (alumel) on front right-hand stud of probe/junction and small diameter T6 terminal (chromel) on opposite smaller diameter stud as follows:

(a) Secure terminals and variable resistor (5) with self-locking nuts (6) and (7) . Tighten and torque nuts (7) for alumel terminals to 24 to 40 lb.in., and nut (6) for chromel terminal to 15 to 20 lb.in.

(b) Install T6 harness loop clamp (9) on remaining rear stud of probe/junction and secure with self-locking nut (7). Tighten and torque nut to 24 to 40 lb.in.

6. Adjustment/Test

A. T1 Thermocouple Harness Insulation, Resistance and Continuity Checks

(1) Inspect T1 thermocouple wiring harness before continuity and resistance checks (Ref. Para. 7.).

(2) Disconnect airframe cable terminals from T1 sensor on airframe air inlet.

(3) Using test set, check insulation resistance between each terminal stud and body of probe. Minimum acceptable resistance is 20,000 ohms. If this check is satisfactory, omit steps (6) and (9), following.

(4) Refer to Chapter 77-00-00, Temperature Sensing System Wiring Diagram. Check continuity (loop resistance) between two terminal studs on T1 sensor at low pressure compressor inlet case (i.e., resistance between chromel terminal E and alumel terminal F). The resistance must be within 10.54 and 13.70 ohms.

(5) Disconnect T6 terminals from T1 probe/junction fitting.

(6) Repeat check at step (3), preceding, to determine insulation resistance of T1 harness. Minimum acceptable resistance is 20,000 ohms. If less, reject T1 harness and omit steps (7) and (8), following.

(7) Remove variable resistor and short-circuit alumel chromel terminal studs at rear of T1 wiring harness.

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(8) Measure resistance across same terminals as in step (4), preceding, to obtain T1 harness continuity resistance. Resistance must be within 10.54 and 12.89 ohms without variable resistance in the circuit. After checking, remove short circuit installed at step (7), preceding.

(9) If T6 thermocouple wiring harness is to be electrically checked, proceed as instructed in Chapter 77-00-02, Adjustment/Test. If not, proceed as follows:

(a) Reconnect T6 harness terminals to T1 probe/junction fitting (Ref. Para. 5.B., preceding).

(b) Reconnect airframe cable terminals to T1 sensor on airframe air inlet.

B. Variable Resistor (Ref. Fig 203)

(1) The variable resistor should not normally require any adjustment. However, if it is believed that resistance value check is required, proceed as follows:

(a) Remove variable resistor (1) from T1 probe/junction fitting (2) at rear of bypass duct (Ref. Para. 5.A.).

(b) Connect leads of test set or a Wheatstone Bridge, across terminals of restrictor and compare measured value with value marked on engine data plate.

CAUTION: UNDER NO CIRCUMSTANCES MAY THE RESISTOR BE SET TO A VALUE LOWER THAN THAT GIVEN ON ENGINE DATA PLATE.

(c) If measured value differs from data plate value by more than 2 ohms, adjust resistor as follows:

1 Remove enamel sealing paint from adjusting screw (3).

2 Turn adjusting screw clockwise to increase, or counterclockwise to decrease resistance.

(d) Following adjustment, reseal adjusting screw (3) with a dab of enamel paint.

(e) Install variable resistor (1) on T1 probe/junction fitting (2) (Ref. Para. 5.B.).

7. Inspection/Check

A. T1 Thermocouple Harness

(1) Inspect harness for signs of damage, broken wires, worn insulation and security in T1 probe housing.

(2) Inspect probes for damage, contact with probe housing and damaged insulation.

(3) Ensure that air gap exists between individual probes of both T1 probe assemblies (Ref. Fig. 204).

(4) Inspect probe housing for damage.

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B. Variable Resistor

(1) Inspect resistor for general condition such as impact marks and surface damage.

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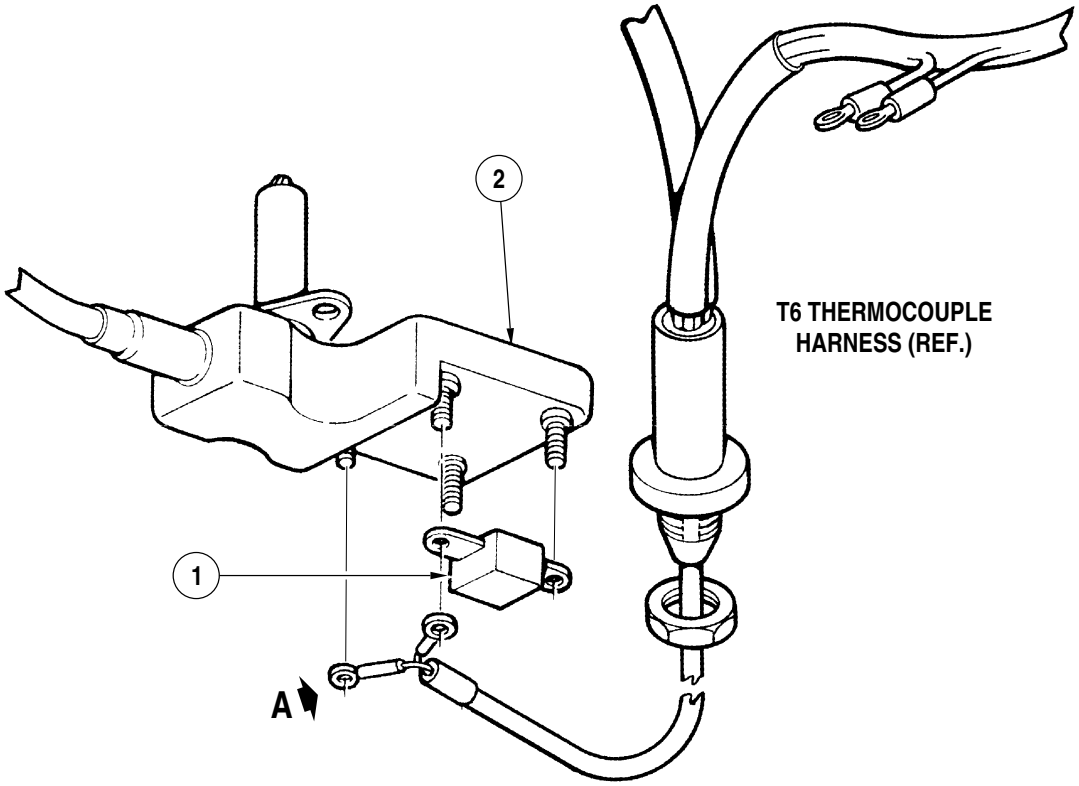

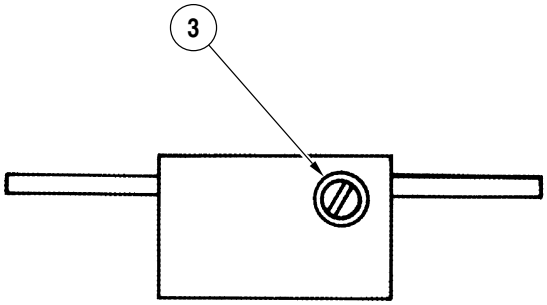

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Variable Resistor Adjustment
Figure 203

Key to Figure 203

1. Variable Resistor
2. T1 Probe/Junction Fitting
3. Adjustable Screw

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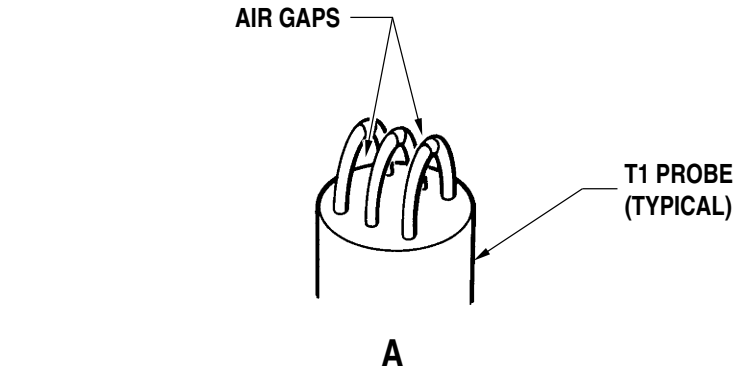

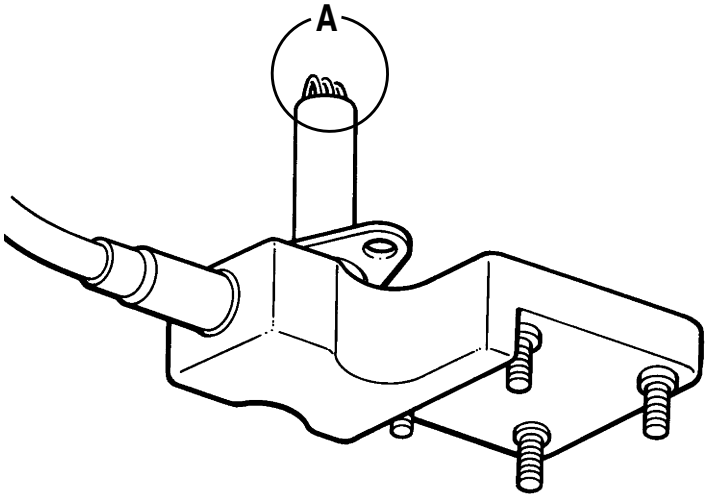

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T1 Probe (Typical)
Figure 204

T6 WIRING HARNESS AND PROBES - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the T6 thermocouple wiring harness and probes.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC05-070	Pressure Sensitive Tape
PWC08-009	Synthetic Ceramic Cement
PWC09-001	Silicone Rubber Sealant
PWC09-001A	Silicone Rubber Sealant
PWC11-027	Petroleum Solvent

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   The fixtures, equipment and supplier tools listed below are used in the following procedures.

Name	Remarks
Test Set, Resistance and Continuity Checks	2312G or TT-1000A

5. Removal/Installation

   A. Removal of T6 Thermocouple Wiring Harness and Probes (Ref. Fig. 201)

      (1) Disconnect T6 terminals (1) and (29) from T1 probe/junction fitting (23) located at 6 o'clock position on bypass duct.

      (2) Remove self-locking nut (27) securing loop clamp assembly (26) and detach clamp from stud. Remove bolt and nut securing support plate (3) to loop clamp on ignition exciter cable.

      (3) Remove self-locking nut (2) securing support plate (3), JT15D-5 (Post-SB7222) and JT15D-5R gasket (4.A) and T6 harness receptacle (5) to pressure fuel tubes fairing (6). Remove support plate (3) and discard Post-SB7222 gasket (4.A).

      (4) Remove pressure fuel tubes fairing (Ref. 73-10-03) .

      (5) Remove rear inner bypass duct (Ref. 72-70-02).

         NOTE: Refer to Airframe Maintenance Manual and remove exhaust tailpipe.

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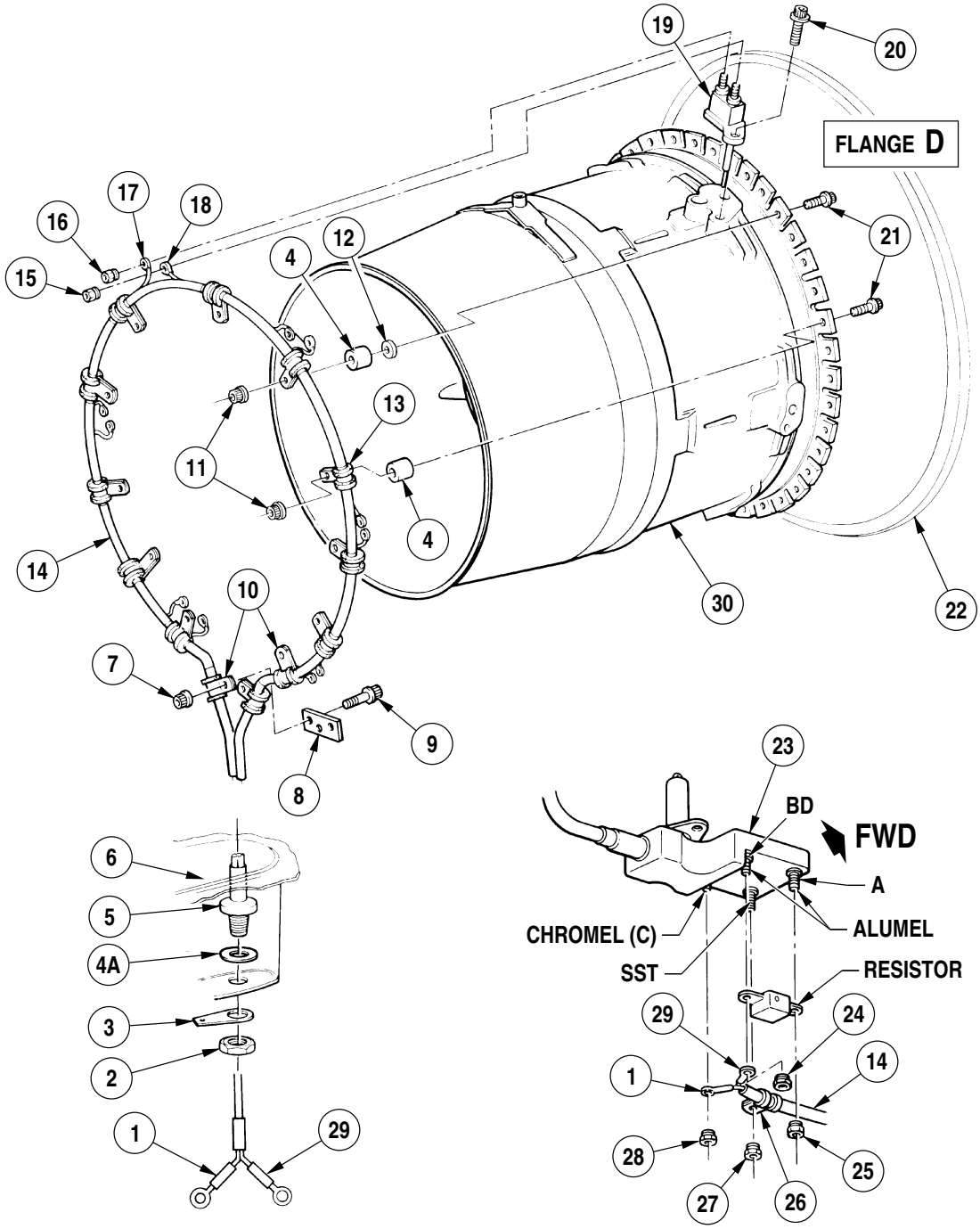

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Removal/Installation - T6 Thermocouple Wiring Harness Assembly
Figure 201 (Sheet 1 of 2)

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Key to Figure 201

1. T6 Terminal (Chromel)
2. Nut
3. Loop Clamp Support Plate
4. Sleeve Spacer
4A. Gasket JT15D-5 (Post-SB7222) and JT15D-5R
5. T6 Harness Receptacle
6. Pressure Fuel Tubes Fairing
7. Self-locking Nut
8. Bracket
9. Bolt
10. Loop Clamp Assembly
11. Self-locking Nut
12. Flat Spacer
13. Loop Clamp Assembly
14. T6 Thermocouple Wiring Harness
15. Self-locking Hex Nut for Alumel Stud
16. Self-locking Hex Nut for Chromel Stud
17. Chromel Lead
18. Alumel Lead
19. T6 Thermocouple
20. Bolt
21. Bolt
22. LP Turbine Stator Support
23. T1 Probe/Junction Fitting
24. Self-locking Hex Nut (for Alumel Stud)
25. Self-locking Hex Nut (for Alumel Stud)
26. Loop Clamp Assembly
27. Self-locking Nut
28. Self-locking Nut (for Chromel Stud)
29. T6 Terminal (Alumel)
30. Turbine Exhaust Duct

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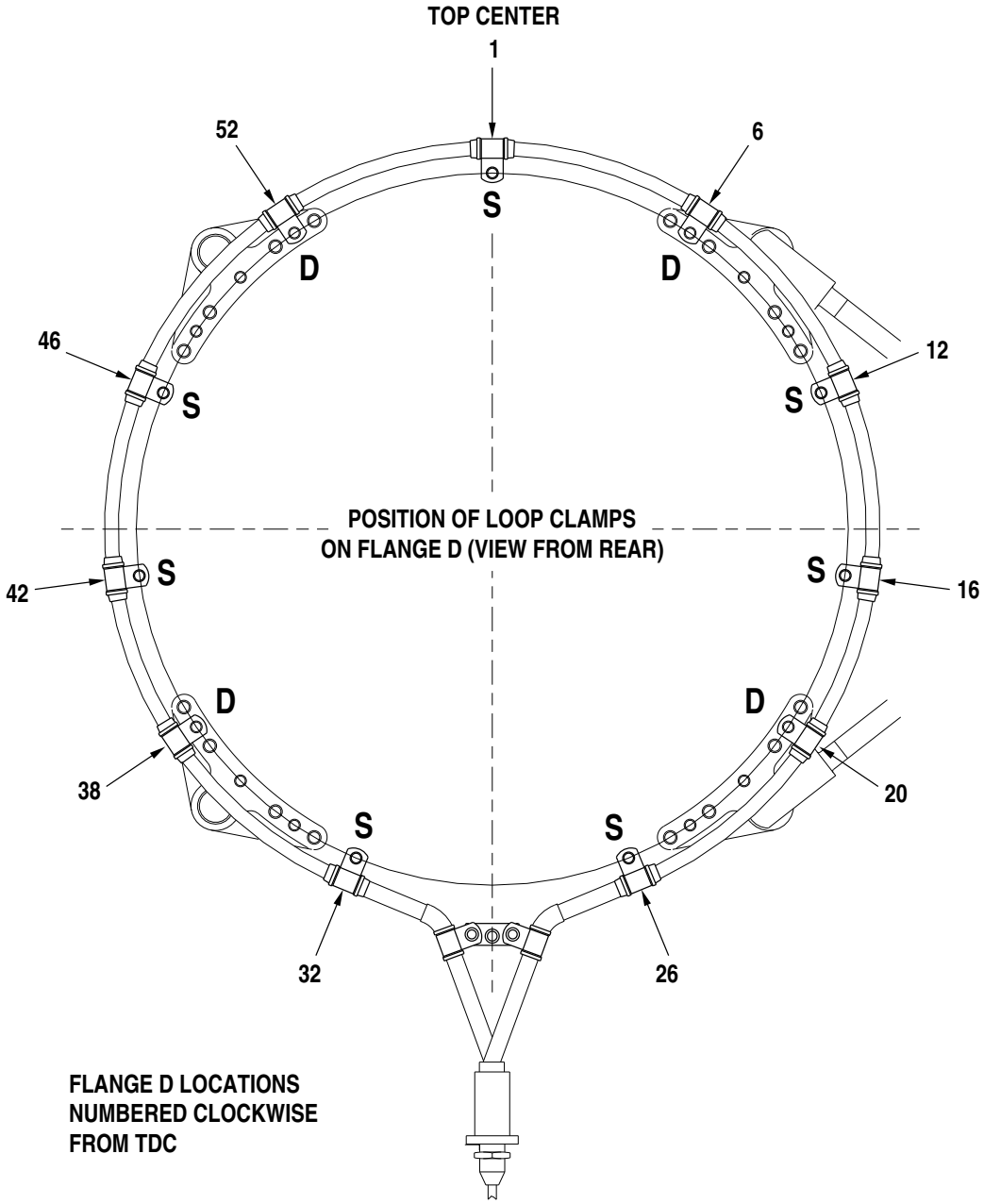

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Removal/Installation - T6 Thermocouple Wiring Harness Assembly
Figure 201 (Sheet 2)

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(6) Remove two terminal nuts (15) and (16) from each of the six thermocouples (19) and detach leads (17) and (18).

(7) Remove six bolts (20) securing thermocouples (19) to turbine exhaust duct (30). Remove thermocouples and store in suitable separate containers.

(8) Remove eleven self-locking nuts (11), sleeve spacers (4), flat spacers (12) and bolts (21) securing eleven loop clamp assemblies (13) to flange D. Note locations of four double spacer assemblies at locations D and seven single spacers at locations S .

(9) Remove two self-locking nuts (7) and two bolts (9) securing two loop clamp assemblies (10) at each side of fuel inlet and shutoff valve housing.

(10) Remove loop clamp assemblies (13) and (10) from T6 thermocouple harness (14) and remove T6 thermocouple harness. Identify harness with engine serial number and store in a suitable container.

B. Installation of T6 Thermocouple Wiring Harness and Probes (Ref. Fig. 201)

(1) Position T6 thermocouple harness (14) on turbine exhaust duct (30) with output terminal housing at 6 o'clock position. Install JT15D-5 (Post-SB7222) and JT15D-5R gasket (4.A) on harness receptacle (5) and insert harness receptacle through port in outer bypass duct.

NOTE: Before completing harness installation, check harness wire bundles are twisted approximately one turn per two inches between loop clamps. Make sure glass cloth wrapped at each loop clamp location is in satisfactory condition. Refer to Para.7.A. for inspection and Para.8.A. for repair.

(2) Insert six thermocouples (19) into appropriate mounting bosses and secure each thermocouple with bolts (20). Torque bolts to 32 to 36 lb.in., and lockwire.

(3) Route yellow (chromel) leads (17) in a clockwise direction and secure each lead to the smaller diameter stud of its respective thermocouple using smaller terminal nuts (16). Torque nuts to 15 to 20 lb.in.

(4) Route red (alumel) leads (18) in a counterclockwise direction and secure each lead to the larger diameter stud of its respective thermocouple using larger terminal nuts (15). Torque nuts to 24 to 40 lb.in.

(5) Check each installed thermocouple for satisfactory heat response (Ref. Para. C.).

(6) Install eleven loop clamp assemblies (13) on T6 thermocouple harness (14) and secure to flange D using eleven self-locking nuts (11), flat spacers (12), sleeve spacers (4) and bolts (21). Ensure correct double spacer assembly at locations D and single spacer installation at locations S. Torque nuts 36 to 40 lb.in.

(7) Secure two loop clamp assemblies (10) to bracket (8) on fuel inlet and shutoff valve housing with self-locking nuts (7) and bolts (9). Torque nuts to 36 to 40 lb.in.

(8) Install pressure fuel tubes fairing (Ref. 73-10-03).

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(9) Install rear inner bypass duct (Ref. 72-70-02)

NOTE: Refer to Airframe Maintenance Manual to install exhaust tailpipe.

(10) Install support plate (3) on T6 thermocouple wiring harness (14) and secure with nut (2). Torque nut 20 to 30 lb.in.

(11) Attach T6 terminals (1) and (29) to T1 probe/junction fitting (23) as follows:

(a) Install larger diameter T6 terminal (29) (alumel) on right-hand front stud BD of probe/junction fitting (23) and smaller diameter T6 terminal (1) (chromel) on right-hand rear stud C.

(b) Secure terminals with self-locking nuts (24) and (28). Torque alumel terminal self-locking nut (24) and (25) to 24 to 40 lb.in., and chromel terminal self-locking nut (28) to 15 to 20 lb.in.

(c) If harness loop clamp assembly (26) was disconnected, install clamp on right-hand rear stud. Secure with self-locking nut (27) and torque to 24 to 40 lb.in.

6. Adjustment/Test

A. T6 Thermocouple Harness Insulation, Resistance and Continuity Checks

(1) Inspect T6 wiring harness and thermocouples before continuity and resistance checks (Ref. Para. 7.).

(2) Disconnect T6 harness output terminals from T1 probe/junction fitting located at 6 o'clock position on bypass duct (Ref. Para. 5.A.).

(3) Using test set , check insulation resistance of T6 harness between each terminal and terminal housing body at 6 o'clock position on bypass duct. Minimum acceptable resistance is 20,000 ohms. If check is satisfactory, omit steps (6) and (8), following.

(4) Use test set, measure T6 harness continuity resistance across chromel and alumel terminals at 6 o'clock position on bypass duct rear. Resistance must be between 0.710 and 0.950 ohms.

CAUTION: TO AVOID DAMAGE TO PROBE INSULATION, SUPPORT THE TERMINALS AND NUTS WHEN TORQUING AND UNTORQUING TERMINAL SCREWS.

(5) Disconnect all six thermocouples from T6 harness (Ref. Para. 5.A.) and support harness connectors clear of terminals and engine.

(6) Repeat step (3), preceding. If resistance measured is less than 20,000 ohms, T6 harness is defective.

(7) Using test set, check loop resistance of each thermocouple circuit in T6 harness by connecting adjacent pairs of leads (red and yellow) in turn. Check that in each instance, resistance is between 2.690 and 4.050 ohms.

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(8) Using test set, check that insulation resistance of each T6 thermocouple measured between terminals and body exceeds 100,000 ohms. If insulation resistance test is unsatisfactory, but does not indicate a direct short to ground:

(a) Bake T6 thermocouple in an oven at 93 °C (200 °F) for one hour to remove all traces of moisture.

(b) Repeat step (8) insulation resistance test.

(c) If still unsatisfactory, the indication is that residual contamination is present in the thermocouple. Reject and replace the T6 thermocouple.

(9) Using test set, check that resistance between terminals of each disconnected T6 thermocouple is between 0.064 and 0.080 ohms.

(10) After satisfactory completion of foregoing checks, reconnect thermocouples to T6 harness (Ref. Para. 5.B.).

(11) Verify correct functioning of all thermocouples and T6 harness by checking each installed thermocouple for satisfactory heat response (Ref. Para. C.).

(12) Reconnect T6 harness terminals to T1 probe junction fitting (Ref. Para. 5.B.).

7. Inspection/Check

A. T6 Thermocouple Harness

(1) Inspect harness for general condition of insulation.

(2) Check for damage to and security of terminals.

(3) Inspect the glass cloth at clamp locations for wear and security. If found worn or broken, replace the glass cloth. Refer to Para.8.A. for approved repairs.

B. T6 Thermocouple Probes

(1) Check security of alumel and chromel terminals. Repair loose terminals (Ref. Para.8.).

(2) Check for cracked or missing insulation in probes. Repair damaged or missing insulation (Ref. Para. 8.).

C. T6 Thermocouple Heat Response Check

(1) Check heat response of each installed thermocouple as follows:

(a) Disconnect T6 harness output terminals from T1 probe/junction fitting located at 6 o'clock position on bypass duct (Ref. Para. 5.A.).

(b) Connect T6 output terminals to leads of electrical test set or to a center-zero galvanometer.

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(c) Working from rear of engine and using a suitable heat source such as a narrow tipped electric soldering iron, apply heat carefully to the thermocouple.

NOTE: The thermocouple tip can be readily located through the gas flow slot near the leading edge of each of the six exhaust duct radial struts.

(d) Remove heat source as soon as any rise in temperature is observed.

CAUTION: CONFIRM THE OUTPUT SIGNAL IS OF THE SAME POLARITY AS THAT FROM THE OTHER PROBES. PROBES GENERATING SIGNAL OF REVERSED POLARITY MUST BE REPLACED BEFORE PROCEEDING TO NEXT PROBE. ALLOW PREVIOUSLY HEATED PROBE TO COOL TO ROOM TEMPERATURE.

(e) On completion of testing, connect T6 output terminals to T1 probe/junction fitting (Ref. Para. 5.A.).

8. Approved Repairs

A. T6 Thermocouple Wiring Harness Repair (Ref. Fig. 202)

(1) T6 Thermocouple Wiring Harness Sealing Tubes:

(a) Wrap tape (PWC05-070) around damaged area.

(b) Apply cement (PWC09-001) or (PWC09-001A) over tape in accordance with manufacturer's instructions.

(c) Allow repair to dry for two hours at room temperature.

(d) Trim off excess cement as required.

(2) Glass Cloth Repair:

(a) Remove damaged glass cloth.

(b) Cut an approximate three inch piece of glass cloth and wrap around harness at clamp location (minimum three full turns required).

B. T6 Thermocouple Probes Repair (Ref. Fig. 203)

(1) Replacement of Missing Insulation:

(a) Prepare synthetic ceramic cement mixture of filler and binder (PWC08-009) by mixing to desired consistency in accordance with manufacturer's instructions.

(b) Clean repaired areas, using petroleum solvent (PWC11-027) and ensure that all surfaces are free from grease or other contaminants.

NOTE: Presence of any contaminant will adversely affect physical and electrical insulating properties of cement mixture.

(c) Apply cement mixture to replace missing insulation.

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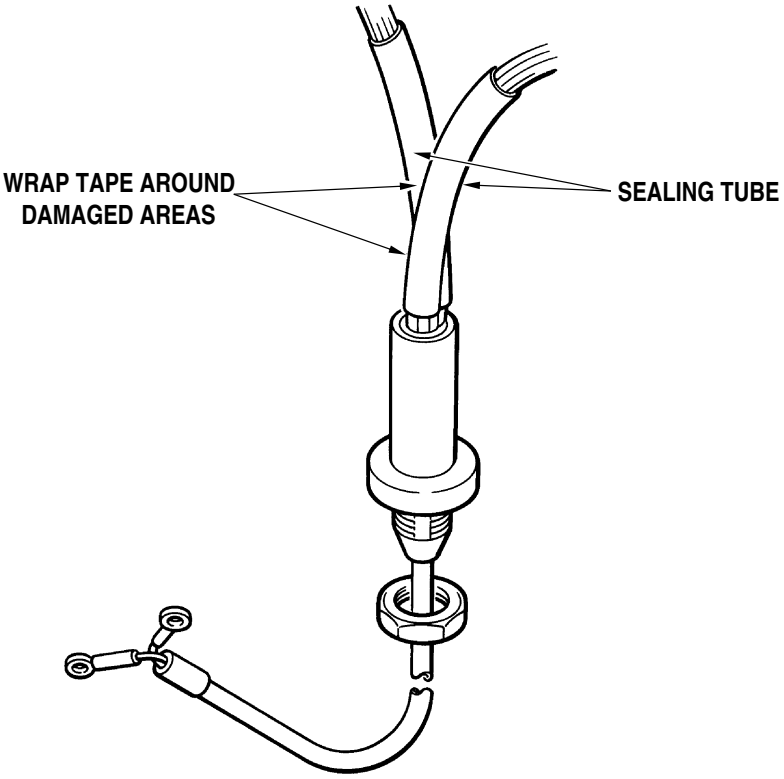

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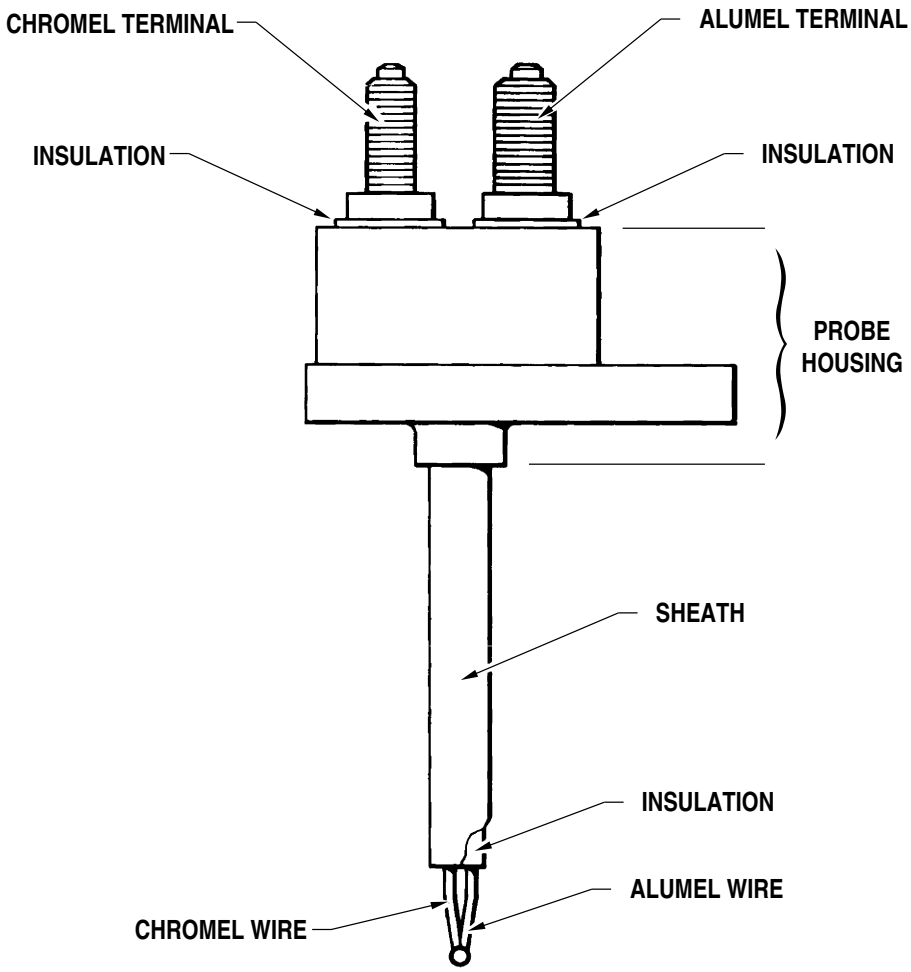
T6 Thermocouple Harness Sealing Tubes
Figure 202



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Repair of T6 Thermocouple Probes
Figure 203

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(d) Allow cement mixture to set. Initial set should take place within 30 minutes. Do not handle or disturb shape during this period.

(e) Cure cement mixture by allowing to air dry for 24 hours or, if more rapid curing is desired, heat in a suitable oven at 65°C (150°F) for three hours.

(2) Repair of Loose Terminal Posts:

(a) Apply a few drops of ceramic binder (PWC08-009) at junction of loose terminal post and surrounding insulation, and allow to set.

(b) Oven dry at 120° to 150°C (250° to 300°F) for 30 minutes to ensure complete drying and setting of binder.

(c) Check security of terminal post in housing and, if still loose, repeat procedure.

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LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
LEP	1	Oct 06/2006
	2 blank	Oct 06/2006
Contents	1	Oct 06/2006
	2 blank	Oct 06/2006
79-00-00	1	Oct 06/2006
Description and	2	Oct 06/2006
Operation	3	Oct 06/2006
	4	Oct 06/2006
	5	Oct 06/2006
	6	Oct 06/2006
79-00-01	101	Oct 22/99
Fault Isolation	102 blank	Oct 22/99
79-00-01	301	Jul 05/2002
Servicing	302 blank	Jul 05/2002
	303 deleted	
	304 deleted	
	305 deleted	
	306 deleted	

TABLE OF CONTENTS

SUBJECT	PAGE
OIL SYSTEM - DESCRIPTION AND OPERATION	**79-00-00**
1. Description and Operation	1
A. General	1
B. Pressure Oil System	1
C. Scavenge Oil System	6
D. Breather System	6
E. Accessory Drive Splines Lubrication	6
OIL SYSTEM - FAULT ISOLATION	**79-00-01**
1. Fault Isolation	101
OIL SYSTEM - SERVICING	**79-00-01**
1. Servicing	301

OIL SYSTEM - DESCRIPTION AND OPERATION

1. Description and Operation (Ref. Fig. 1 and 2)

A. General

The lubrication system is designed to supply clean lubricating oil, at a constant pressure, to the engine bearings and all accessory drive gears and bearings. The oil flow lubricates and cools the bearings and carries foreign matter to the oil filter where it is retained. Calibrated oil nozzles on the main engine bearing compartments ensure that an optimum oil flow is maintained under all operating conditions. The system consists of a pressure system, a scavenge system and breather system.

B. Pressure Oil System

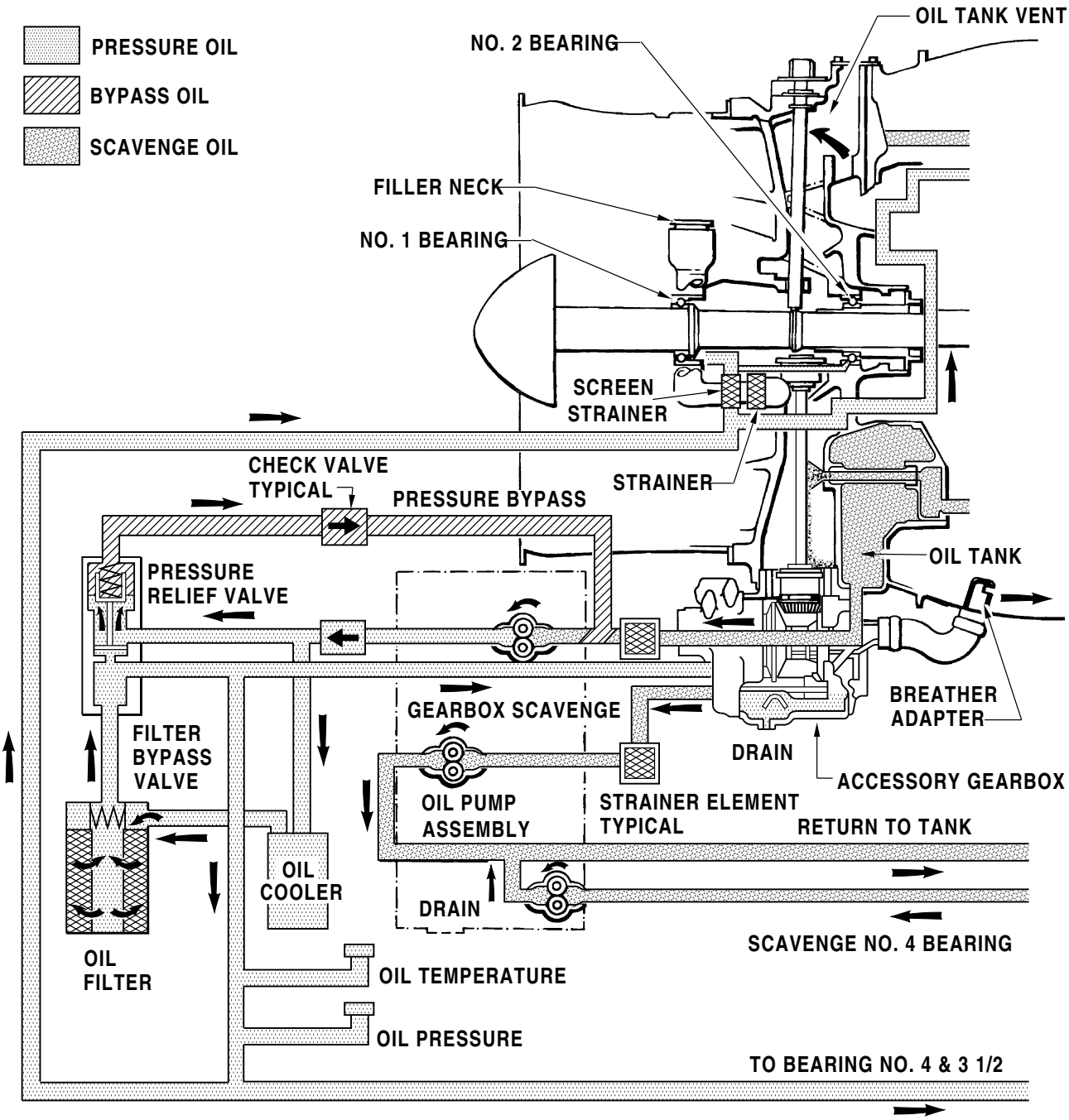
Oil drawn from the tank by the pressure oil pump element is ducted through a check valve to the pressure relief valve inlet of the oil filter housing. The oil also goes to the oil cooler, which is mounted on the oil filter housing and the filter element, which, in the event of clogging, is bypassed by a valve. Oil pressure in excess of specification pressure at the oil filter outlet (Ref. Fig. 1) opens the pressure regulating valve and some of the oil is bypassed and ducted externally through a second check valve to the oil pressure pump inlet.

For the JT15D-5R the oil from the pump first goes through a Fuel/Oil Heat Exchanger before it goes to the oil cooler. The fuel temperature is sensed by a Thermostatic Bypass Valve (TBV). Once the fuel temperature reaches a predetermined value, the TBV bypasses the FOHE and sends the oil to the oil cooler. The JT15D-5R also has antisiphon tubes as part of the pressure oil delivery.

An external transfer tube routes oil to a boss located in the 5 o'clock position at the rear of the engine, and an internal transfer tube takes the oil to the No. 4 bearing housing. In the No. 4 bearing housing, part of the oil is passed through two calibrated lubrication nozzles that spray the No. 4 bearing cage and rollers. Pressure oil is also directed through a central port in the bearing housing cover directly into the intershaft oil transfer tube. A carbon seal in the cover prevents oil leakage between the rotating transfer tube and the stationary cover. From the transfer tube oil, is centrifuged through two drillings in the low pressure turbine shaft to two circumferential grooves in the inner surface of the No.3-1/2 bearing inner race. Internal passages within the inner race, ensure complete lubrication of the bearing surfaces, rollers and cage.

A second external transfer tube routes oil to a boss in the 4 o'clock position on the intermediate casing, to provide lubrication for the Nos. 1, 2 and 3 bearings and the bevel and spur gears located in the intermediate case.

An internal transfer tube located between the oil filter housing and the accessory gearbox routes pressure oil to the gearbox for gearbox bearing lubrication.



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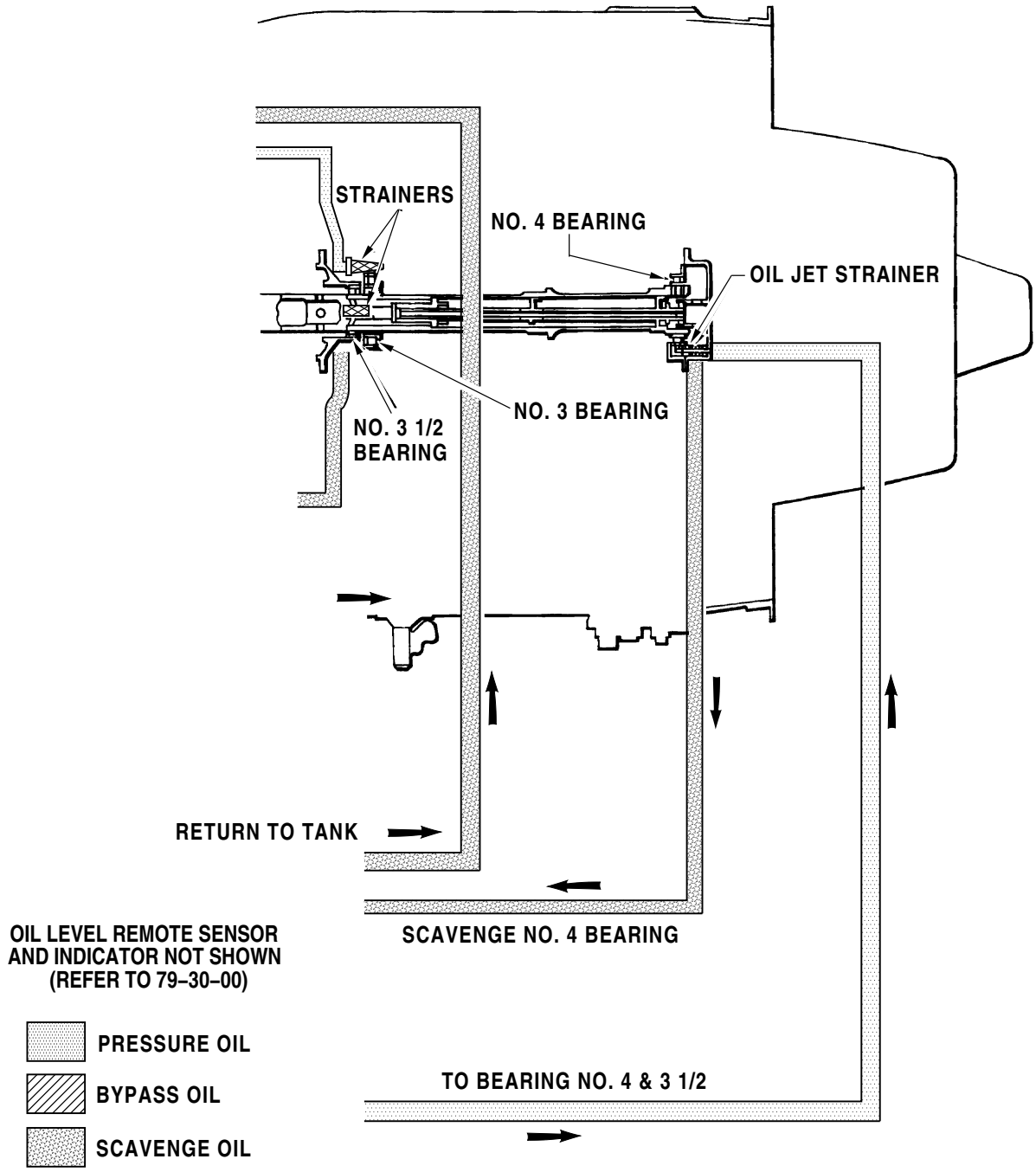
JT15D-5 Engine Lubrication System - Schematic
Figure 1 (Sheet 1 of 2)



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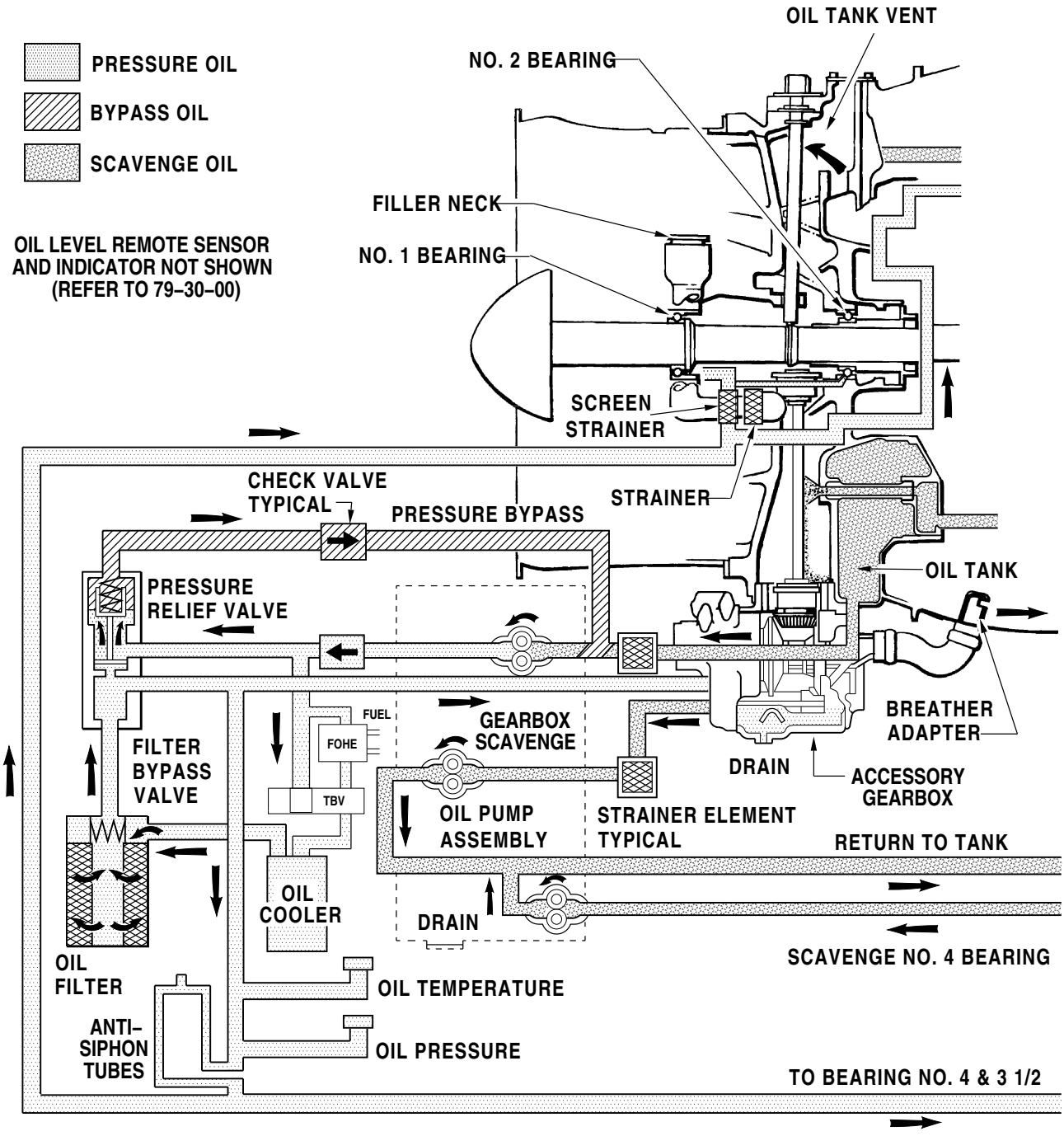
JT15D-5 Engine Lubrication System - Schematic
Figure 1 (Sheet 2)



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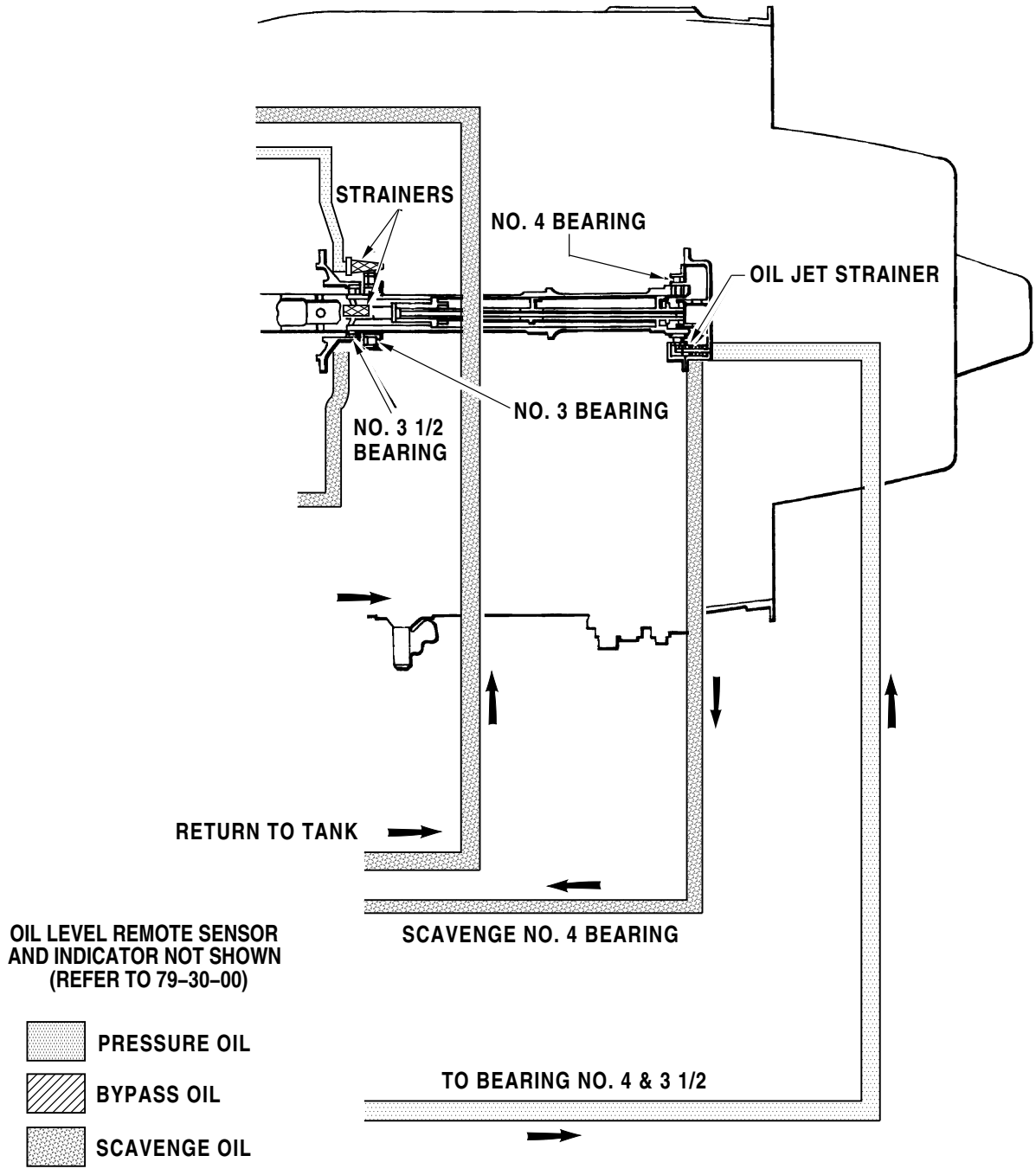
JT15D-5R Engine Lubrication System - Schematic
Figure 2 (Sheet 1 of 2)



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JT15D-5R Engine Lubrication System - Schematic
Figure 2 (Sheet 2)

C. Scavenge Oil System

The function of the scavenge oil system is to return used oil to the tank. This is achieved by allowing the oil from Nos. 1, 2, 3 and 3-1/2 bearings to drain into the accessory gearbox, aided by the airflow from the bearing compartment labyrinth seals. The No.4 bearing scavenge oil is pumped by a separate pump element in the oil pump assembly.

The scavenge oil returned to the accessory gearbox collects in a sump at the bottom of the housing. Sump oil is pumped out by a separate and larger scavenge pump element. This pump element returns gearbox scavenge oil to the oil tank. Scavenge oil is returned to the oil tank through an external transfer tube on the left-hand side of the engine which connects to a boss in the 12 o'clock position on the intermediate casing; from this boss, the oil flows directly to the tank.

D. Breather System

Breather air from the engine bearing compartments and from the accessory gearbox is vented overboard through an impeller-type centrifugal breather installed in the accessory gearbox. The bearing compartments are connected to the accessory gearbox by cored passages and existing scavenge oil return lines.

The common bearing compartment, housing the No. 1 and No. 2 bearings, vents via a hollow strut into the accessory gearbox. The No. 3 bearing area and the No. 3-1/2 bearing compartment are vented to the accessory gearbox via the No. 3 bearing housing scavenge oil drain. The No. 4 bearing compartment is vented to the oil tank via the No. 4 bearing scavenge oil tube. The oil tank is vented to the intermediate case.

E. Accessory Drive Splines Lubrication

The accessory gearbox hydraulic pump and fuel pump drive splines are oil mist lubricated. Continuous wet-spline drive is provided by means of two diametrically opposite holes in each gearshaft picking up oil mist in the gearbox.

OIL SYSTEM - FAULT ISOLATION

1. Fault Isolation

   For detailed fault isolation procedures for engine oil system, refer to Chapter 72-00-00, FAULT ISOLATION, Fault Isolation for Engine Lubrication Problems.

OIL SYSTEM - SERVICING

1. Servicing

Procedures for servicing the engine oil system have been relocated to 72-00-00, SERVICING.

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
LEP	1	May 13/2013
	2 blank	May 13/2013
Contents	1	May 13/2013
	2	May 13/2013
	3	May 13/2013
	4 blank	May 13/2013
79-20-00	1	Oct 06/2006
Description and Operation	2	Oct 06/2006
79-20-01	1	Oct 06/2006
Description and Operation	2 blank	Oct 06/2006
79-20-01	201	May 13/2013
Maintenance	202	May 13/2013
Practices	203	May 13/2013
	204	May 13/2013
	205	May 13/2013
	206	May 13/2013
	207	May 13/2013
	208	May 13/2013
	209	May 13/2013
	210	May 13/2013
	211	May 13/2013
	212	May 13/2013
	213	May 13/2013
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	215	May 13/2013
	216	May 13/2013
	217	May 13/2013
	218	May 13/2013
	219	May 13/2013
	220	May 13/2013
	221	May 13/2013
	222	May 13/2013
	223 deleted	
	224 deleted	

CHAPTER SECTION	PAGE	DATE
79-20-02	1	Oct 06/2006
Description and Operation	2 blank	Oct 06/2006
79-20-02	201	May 13/2013
Maintenance	202	May 13/2013
Practices	203	May 13/2013
	204	May 13/2013
	205	May 13/2013
	206	May 13/2013
	207	May 13/2013
	208 blank	May 13/2013
79-20-03	201	Oct 06/2006
Maintenance	202	Oct 06/2006
Practices	203	Oct 06/2006
	204	Oct 06/2006
79-20-04	201	Oct 06/2006
Maintenance	202	Oct 06/2006
Practices	203	Oct 06/2006
	204	Oct 06/2006
	205	Oct 06/2006
	206 blank	Oct 06/2006

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TABLE OF CONTENTS

SUBJECT	PAGE
DISTRIBUTION (JT15D-5) - DESCRIPTION AND OPERATION	**79-20-00**
1. Description and Operation	1
A. Oil Tank	1
B. Oil Pump	1
C. Oil Filter	1
D. Centrifugal Breather	1
OIL FILTER HOUSING (JT15D-5) - DESCRIPTION AND OPERATION	**79-20-01**
1. Description and Operation	1
OIL FILTER HOUSING (JT15D-5) - MAINTENANCE PRACTICES	**79-20-01**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Servicing	201
6. Removal/Installation	201
A. Removal of Oil Filter Element and Cover	201
B. Installation of Oil Filter Element and Cover	203
C. Removal of Oil Pressure Regulating Valve	204
D. Installation of Oil Pressure Regulating Valve	204
E. Removal of Oil Filter Bypass Valve	205
F. Installation of Oil Filter Bypass Valve	205
7. Adjustment/Test	207
A. Adjustment of Oil Pressure Regulating Valve	207
8. Cleaning	208
A. Pre-SB7476 Oil Filter Element	208
B. Oil Filter Housing	210

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
OIL FILTER HOUSING (JT15D-5) - MAINTENANCE PRACTICES (Cont'd)	**79-20-01**
C. Oil Pressure Regulating Valve	210
9. Inspection/Check	210
A. Oil Filter Element	210
B. Determine Composition of Debris	211
C. Laboratory Inspection of Metallic Debris	214
D. Laboratory Inspection of Engine Oil Sample	215
10. Fits, Clearances and Torque Loadings	219
A. General	219
CHECK VALVES AND TUBES (JT15D-5) - DESCRIPTION AND OPERATION	**79-20-02**
1. Check Valves	1
CHECK VALVES AND TUBES (JT15D-5) - MAINTENANCE PRACTICES	**79-20-02**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal of Check Valves	201
B. Installation of Check Valves	203
6. Fits, Clearances and Torque Loadings	205
EXTERNAL PRESSURE OIL TUBES (JT15D-5) - MAINTENANCE PRACTICES	**79-20-03**
1. General	201
2. Consumable Materials	201
3. Special Tools	201

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The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
EXTERNAL PRESSURE OIL TUBES (JT15D-5) - MAINTENANCE PRACTICES (Cont'd)	**79-20-03**
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal of No. 1, 2, 3 and 4 Bearings Pressure Oil Tubes	201
B. Installation of No. 1, 2, 3 and 4 Bearings Pressure Oil Tubes	203
6. Inspection/Check	204
A. Procedure	204
7. Cleaning/Painting	204
A. Procedure	204
EXTERNAL SCAVENGE OIL TUBES (JT15D-5) - MAINTENANCE PRACTICES	**79-20-04**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal of No. 4 Bearing Oil Scavenge and Oil Return-to-Tank Tubes	201
B. Installation of No. 4 Bearing Oil Scavenge and Oil Return-to-Tank Tubes	203
6. Inspection/Check	204
A. Procedure	204
7. Cleaning/Painting	205
A. Procedure	205

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DISTRIBUTION (JT15D-5) - DESCRIPTION AND OPERATION

1. Description and Operation

A. Oil Tank

The oil tank is an integral part of the intermediate case and is sealed at the rear by a cover which provides transfer tube pickup locations and internal passageways for pressure oil to the No. 3 bearing and scavenge oil from the Nos. 3 and 3-½ bearings.

The tank is provided with an oil filler-neck, dipstick and cap assembly, which can be mounted to either side of the intermediate case front flange. The oil level in the tank is equal to the level in the filler-neck and is indicated by the dipstick. The tank vents to the intermediate case.

For oil tank data, refer to Chapter 79-00-01, OIL SYSTEM - SERVICING.

B. Oil Pump (Ref. Fig. 1)

Pressure oil is circulated from the integral oil tank through the engine lubrication system by the oil pump pressure spur gears. The oil pump scavenge spur gears operate to pump scavenge oil from the accessory gearbox and the No. 4 bearing housing to the tank via a boss at the top left engine mount pad.

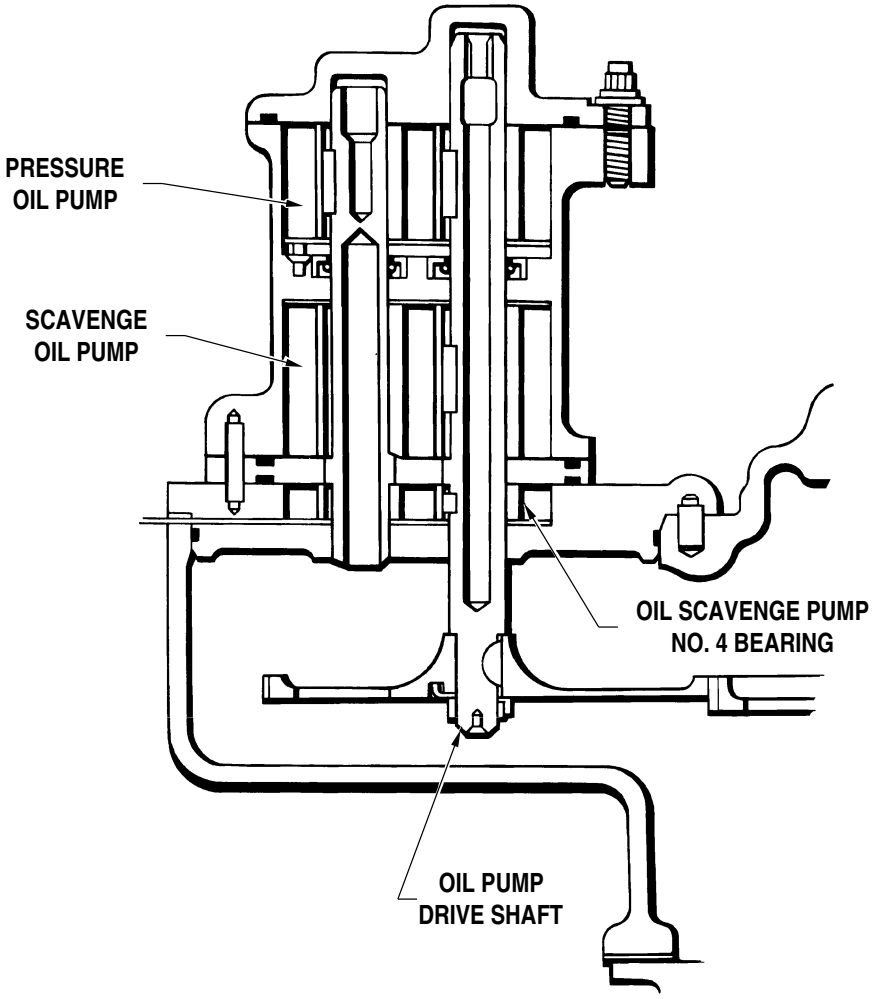
The oil pump assembly is mounted on and driven by a gear in the accessory gearbox. The oil pump housing incorporates a drain plug for draining the oil tank, which must be accomplished before the pump assembly is removed.

C. Oil Filter

The 10-micron oil filter, which may be cleaned and reused, is housed in the oil filter housing assembly and retained within a cover. Oil passes from the outside of the filter to the center and then out through the housing at the top. In the event that the oil filter becomes blocked, the bypass valve in the housing will open, allowing unfiltered oil to pass through to the engine. A plug at the bottom of the cover allows the filter assembly to be drained before removal.

D. Centrifugal Breather

Air from the engine bearing compartments and the accessory gearbox is extracted from the air/oil mist and vented overboard through the action of an aluminum alloy, impeller-type centrifugal breather. The breather is mounted on the main shaft assembly of the gearbox. The pressure difference between the air in the gearbox and the ambient atmosphere causes the air/oil mist in the gearbox to flow radially inward through the impeller. As the mist passes through the impeller, the oil particles adhere to the vanes and are thrown radially outward by centrifugal force. The relatively oil free air passes through the hollow main shaft to a breather adapter, mounted at the rear on the gearbox cover. An airframe-supplied overboard vent line must be connected to the gearbox breather adapter.



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Oil Pump
Figure 1

OIL FILTER HOUSING (JT15D-5) - DESCRIPTION AND OPERATION

1. Description and Operation

The oil filter housing assembly is mounted on the accessory gearbox, on the right side of the engine. The assembly comprises a removable alloy filter housing containing a cleanable oil filter element, two check valves, a pressure relief valve assembly and an oil filter bypass valve. Bosses at the top of the housing provide for the installation of an oil temperature bulb and an oil pressure transmitter. The oil cooler is mounted on the side of the oil filter housing.

The two check valves in the system close under spring loading to prevent gravity oil flow when the engine is not running and also allow oil system components, such as the oil filter and external transfer tubes downstream of the check valves, to be removed for servicing without draining the oil tank.

The spring-loaded filter bypass valve is installed at the oil inlet end of the filter element housing and is normally closed. In the event of filter blockage, increased pressure overcomes the bypass valve spring force and opens the valve to permit an unrestricted, unfiltered oil flow to the bearings.

Engine oil pressure is regulated by a spring-loaded piston-type valve which operates in a ported sleeve. The valve senses oil pressure downstream of the filter and all excess oil in excess of the regulated pressure is returned directly to the tank.

OIL FILTER HOUSING (JT15D-5) - MAINTENANCE PRACTICES

1. General

   A. The following describes removal, servicing and installation of oil filter element, housing and relief valve. Refer to INTRODUCTION for Build Specification (BS) details.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC05-128	Lapping Compound
PWC11-027	Petroleum Solvent

3. Special Tools

   The special tools listed below are used in the following procedures.

Tool No.	Name
PWC31571	Adjusting Tool, OPRV
PWC31660	Puller
PWC31871	Adjusting Tool
PWC52451	Driver, Lapping

4. Fixtures, Equipment and Supplier Tools

   The fixtures, equipment and supplier tools listed below are used in the following procedures.

Name	Remarks
Electrosonic Cleaner	Kellstrom KS5518 (not used for Post-SB7476 engine oil filter element)

5. Servicing

   Refer to Chapter 72-00-00, SERVICING for oil system servicing.

6. Removal/Installation

   A. Removal of Oil Filter Element and Cover (Ref. Fig. 201)

      (1) Removal of Oil Filter Element

      CAUTION: WHENEVER OIL FILTER ELEMENT IS BEING REMOVED FOR A ROUTINE CHECK OR AS A TROUBLESHOOTING AID, THE OIL FILTER COVER SHOULD NOT BE DRAINED PRIOR TO REMOVAL IN ORDER TO FACILITATE INSPECTION OF CONTENTS.

      (a) If engine oil is to be inspected, remove drain plug (11) and collect oil in a clean container. Remove and discard preformed packing (10).

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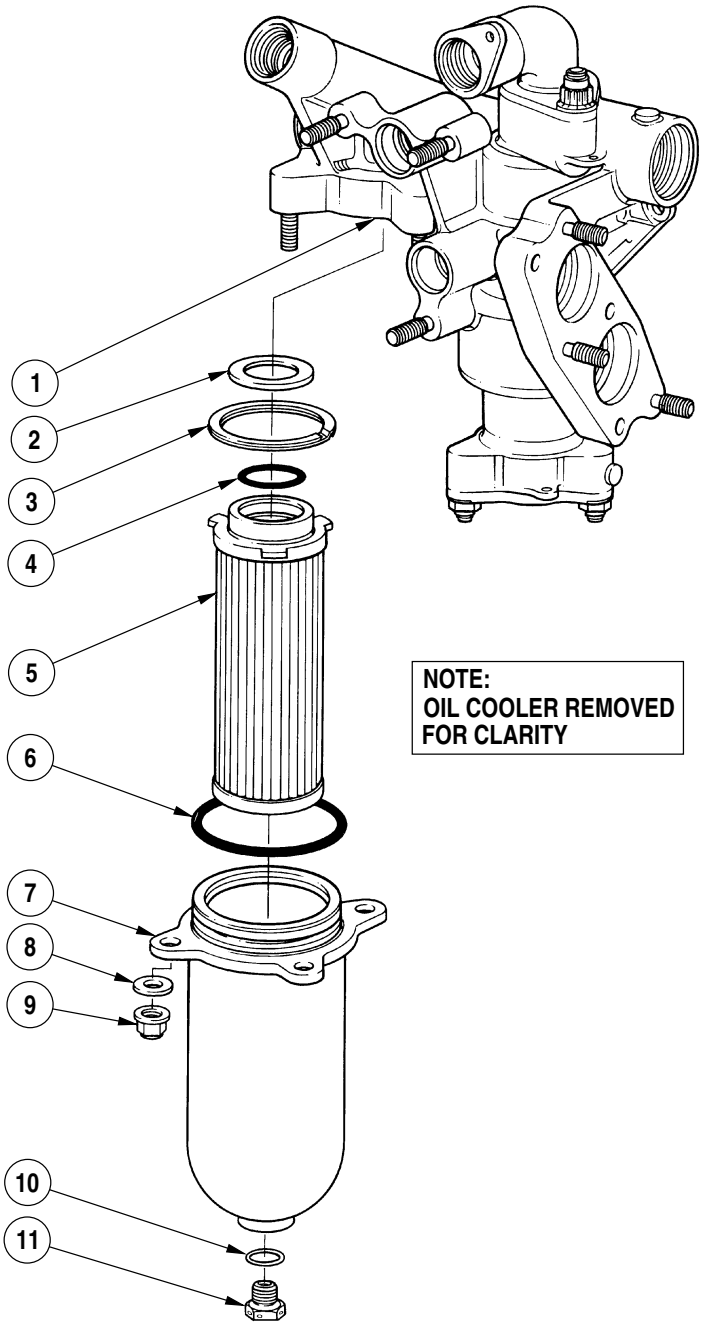

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Removal/Installation - Oil Filter Element and Cover
Figure 201

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Key to Figure 201

1. Oil Filter Housing Assembly
2. Spacer
3. Retaining Ring
4. Preformed Packing
5. Oil Filter Element
6. Preformed Packing
7. Oil Filter Cover
8. Washer
9. Self-locking Nut
10. Preformed Packing
11. Drain Plug

(b) Remove four self-locking nuts (9) and washers (8) holding oil filter cover (7) to oil filter housing assembly (1).

(c) Remove oil filter cover (7) with oil filter element (5) installed.

(d) Remove retaining ring (3) and remove filter element.

B. Installation of Oil Filter Element and Cover (Ref. Fig. 201)

(1) Installation of Oil Filter Element

(a) Clean oil filter element and housing prior to installing (Ref. Para. 8.).

(b) Install new preformed packing (4) in oil filter element (5) and new preformed packing (6) on oil filter cover (7).

(c) Insert oil filter element (5) into oil filter cover (7) with the three tangs up and secure with retaining ring (3).

(d) Position spacer (2) on oil filter housing assembly (1).

(e) Install oil filter cover (7) with oil filter element (5). Secure with four washers (8) and self-locking nuts (9). Torque nuts 65 to 85 lb.in.

CAUTION: DO NOT TIGHTEN DRAIN PLUG MORE THAN MAXIMUM TORQUE VALUE.

(f) If removed, install new preformed packing (10) on oil filter cover drain plug (11). Install drain plug and tighten as follows:

1 Raytheon BS713: torque oil filter cover drain plug 40 to 50 lb.in. then lockwire.

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2 Mitsubishi BS657: for engines incorporating P/N 3108816-01 oil filter cover assembly, install drain plug, torque 40 to 50 lb.in. then lockwire. For engines incorporating P/N 3102998-01 oil filter cover assembly, install drain plug, torque 65 to 75 lb.in. then lockwire.

NOTE: For further information, refer to Parts Digest No. 2665.

(g) Service engine oil system (Ref. 72-00-00, SERVICING).

C. Removal of Oil Pressure Regulating Valve (Ref. Fig. 202)

(1) Drain residual oil from oil filter housing (11). Discard preformed packing. Remove three bolts (23) and washers (22) attaching drain adapter (21)(BS657 and BS713 installations).

(2) Remove drain adapter (21)(BS657 and BS713 installations) with preformed packing (20). Discard preformed packing.

(3) Loosen valve spring seat (18) using adjusting tool (PWC31571) or (PWC31871).

NOTE: 1. For reference at assembly, record number of turns valve seat was threaded into housing.

NOTE: 2. For Pre-SB7231 engines incorporating P/N 3102997-01 oil filter housing only, use adjusting tool (PWC31571). For all other engines, use adjusting tool (PWC31871).

(4) Remove pressure regulating valve spring seat (18) with compression spring (17) and remove pressure relief valve (16).

(5) If required to remove sleeve (15):

(a) Remove retaining ring (19).

(b) Install puller (PWC31660) and remove sleeve.

(c) Remove and discard two preformed packings (14) from sleeve (15).

D. Installation of Oil Pressure Regulating Valve (Ref. Fig. 202)

(1) If sleeve (15) was removed, reinstall as follows:

(a) Install two new preformed packings (14) onto sleeve (15).

(b) Carefully insert sleeve (15) and push into oil filter housing (11) using puller (PWC31660). Ensure sleeve is fully seated in oil filter housing.

(c) Install retaining ring (19) and remove puller (PWC31660).

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(2) Insert one end of compression spring (17) over stem of regulating valve (16) and other end into pressure regulating valve spring seat (18). Insert parts into regulating valve housing and screw seat (18) inward with adjusting tool (PWC31571) or (PWC31871), the same number of turns as recorded during removal.

NOTE: For Pre-SB7231 engines incorporating P/N 3102997-01 oil filter housing only, use adjusting tool (PWC31571). For all other engines, use adjusting tool (PWC31871).

(3) Install new preformed packing (20) on drain adapter (21).

(4) Install drain adapter (21) as follows:

(a) BS657 and BS713 installation: secure drain adapter with three washers (22) and three bolts (23). Tighten and torque bolts 32 to 36 lb.in. Lockwire bolts.

NOTE: Ensure that lugs on pressure regulating valve spring seat (18) are aligned with locking slot in drain adapter (21). If necessary, minimally rotate spring seat to obtain alignment.

E. Removal of Oil Filter Bypass Valve (Ref. Fig. 202)

(1) Remove cap assembly (1) or adapter (2), preformed packing (3) and washer (4). Discard packing

(2) Remove bypass valve (6) and helical compression spring (5) from oil filter housing (11).

(3) Remove plug (7) and preformed packing (8). Discard packing.

F. Installation of Oil Filter Bypass Valve (Ref. Fig. 202)

(1) Install preformed packing (3) and washer (4) on adapter (2).

(2) On a clean work bench apply a small quantity of lapping compound (PWC05-128) to the chamfer of the bypass valve (6).

(3) Put the valve into the oil filter housing (11). Use lapping driver (PWC52451) to apply a light pressure and rotate the valve against the mating surface in the oil filter housing.

(4) Remove the lapping driver (PWC52451) and the bypass valve (6) from the oil filter housing.

(5) Use petroleum solvent (PWC11-027) to clean the bypass valve and the bypass valve port in the oil filter housing (Ref. 70-00-00, STANDARD PRACTICES - CLEANING).

(6) Drain all cleaning fluid from the parts. Use clean compressed air to remove all residual fluid, if necessary.

(7) Insert bypass valve (6) in oil filter housing (11) and locate compression spring (5) in bypass valve.

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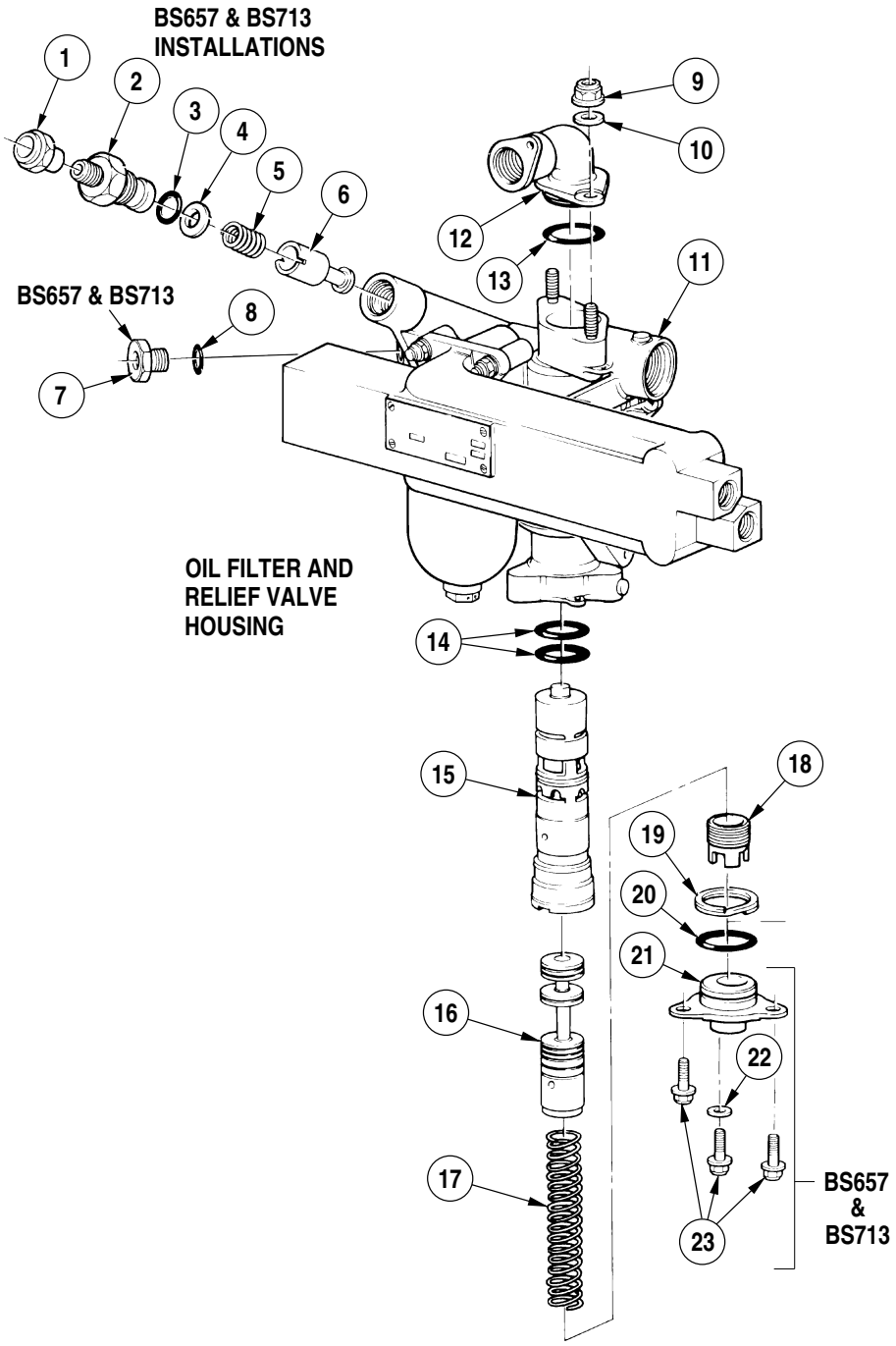

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Removal/Installation - Oil Pressure Regulating Valve and Filter Bypass Valve Assembly
Figure 202

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Key to Figure 202

1. Cap Assembly (BS657 and BS713 Installations)
2. Adapter (BS657 and BS713 Installations)
3. Preformed Packing (BS657 and BS713 Installations)
4. Washer (BS657 and BS713 Installations)
5. Helical Compression Spring
6. Oil Filter Bypass Valve
7. Plug
8. Preformed Packing (BS657 and BS713 Installations)
9. Self-locking Nut
10. Washer
11. Oil Filter Housing (BS657 and BS713 Installations)
12. Elbow
13. Preformed Packing
14. Preformed Packing
15. Sleeve
16. Pressure Relief Valve
17. Helical Compression Spring
18. Pressure Regulating Valve Spring Seat
19. Retaining Ring
20. Preformed Packing
21. Drain Adapter (BS657 and BS713 Installations)
22. Washer (BS657 and BS713 Installations)
23. Bolt (BS657 and BS713 Installations)

(8) Carefully install adapter (2) in oil filter housing (11). Tighten and torque adapter 135 to 150 lb.in.

(9) Install cap (1) on adapter (2). Tighten and torque cap 135 to 150 lb.in. Lockwire assembly.

(10) Install preformed packing (8) on plug (7). Install plug with preformed packing on oil filter housing (11). Tighten and torque plug 65 to 75 lb.in. Lockwire plug.

7. Adjustment/Test

A. Adjustment of Oil Pressure Regulating Valve (Ref. Fig. 202)

NOTE: Engines must be shut down during adjustment of oil pressure regulating valve, except as noted.

(1) BS657 and BS713 installation: remove three bolts (23) and washers (22).

(2) Remove drain adapter (21) (BS657 and BS713 installation) with preformed packing (20). Discard preformed packing.

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(3) For Pre-SB7231 engines incorporating P/N 3102997-01 oil filter housing assembly only, install adjusting tool (PWC31571). For all other engines, use adjusting tool (PWC31871).

(4) Install adjusting tool (PWC31571) or (PWC31871). Adjust pressure regulating valve spring seat (18) clockwise to increase oil pressure, or counterclockwise to decrease oil pressure.

NOTE: 1. An adjustment of one turn will change oil pressure 3 to 5 psi.

NOTE: 2. If adjusting tool (PWC31571) or (PWC31871) only is used, adjustment may be performed while the engine is running.

(5) Remove adjusting tool (PWC31871) or (PWC31871).

NOTE: Ensure that lugs on pressure regulating valve spring seat (18) are aligned with locking slot in drain adapter (21). If required, rotate spring seat minimally to obtain alignment.

(6) BS657 and BS713 installation: install new preformed packing (20) on drain adapter (21). Mount drain adapter on housing (11) and secure with three washers (22) and bolts (23). Tighten and torque bolts to 32 to 36 lb.in.

8. Cleaning

A. Pre-SB7476 Oil Filter Element

NOTE: The following oil filter element cleaning procedure applies only to Pre-SB7476 oil filters. Post-SB7476 and Post-SB7581 oil filters are of a non-cleanable design.

(1) Seal central tube opening of element using a suitable size rubber or plastic plug.

(2) Place filter element in tank of electrosonic cleaner.

(3) Sonac S-2 Electrosonic Cleaner (Ref. Fig. 203)

(a) Pour sufficient quantity of petroleum solvent (PWC11-027) into cleaning tank. Keep fluid level approximately ¼ inch below tank edge to avoid spillage.

(b) Operate cleaner for ten minutes.

(c) Rotate filter element 180 degrees and operate cleaner for a further ten minutes.

NOTE: It may be required to vary duration of cleaning interval, depending upon filter element condition. However, for optimum results, solvent should be replaced after 20 minutes of cleaning.

(4) Kellstrom KS5518 Electrosonic Cleaner:

(a) Pour enough petroleum solvent (PWC11-027) into cleaning tank to completely immerse oil filter element.

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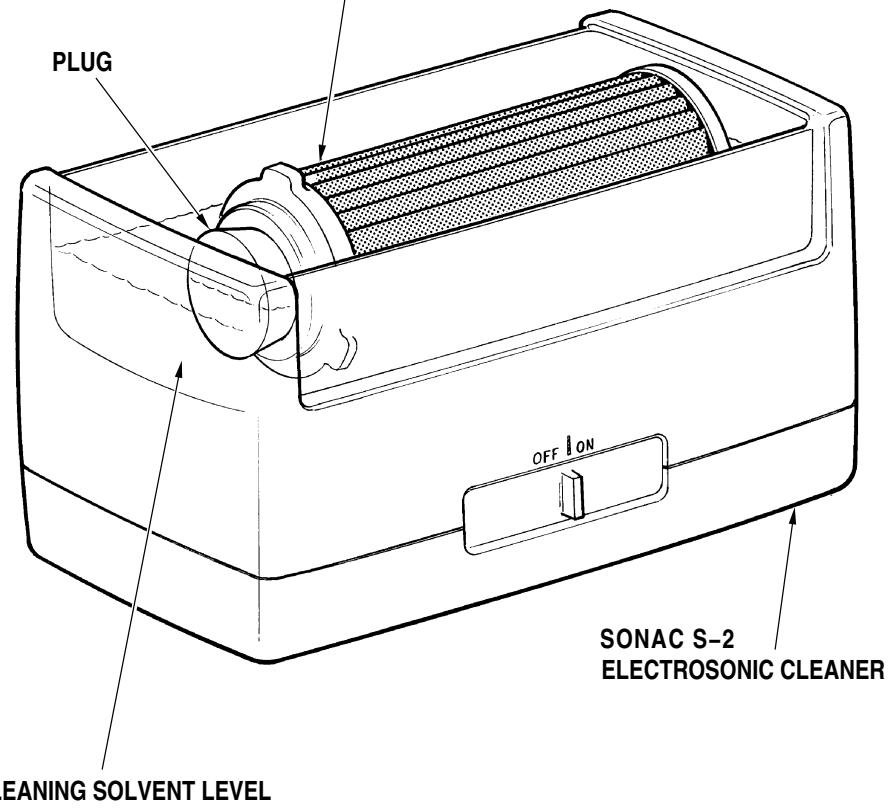

NOTE : KEEP FLUID LEVEL
1/4 INCH BELOW TANK
EDGE TO AVOID SPILLAGE.

PRE-SB7476 OIL FILTER ELEMENT ONLY C6816C

Electrosonic Field Cleaning of Pre-SB7476 Engine Oil Filter
Figure 203

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(b) Operate cleaner for 20 minutes.

NOTE: Cleaning duration may require adjusting, depending upon filter element condition. However, for optimum results, solvent should be replaced after 20 minutes of cleaning.

(5) After cleaning oil filter element with Sonac S-2 or Kellstrom KS5518 electrosonic cleaner, proceed as follows:

(a) Wearing clean lint-free gloves, remove element from tank and remove plug from central tube opening. Blow dry filter element using clean, dry, filtered compressed air, or allow filter element to stand and air dry.

(b) Inspect filter element visually (Ref. Para. 9.) and repeat cleaning process, if necessary. Reinspect: if results are not satisfactory, send element to an approved overhaul facility for more detailed inspection and cleaning.

(c) Check and clean inside of oil filter housing before reinstalling oil filter element.

B. Oil Filter Housing

(1) Check and clean inside of oil filter element housing before reinstalling element. Wash in petroleum solvent (PWC11-027) and use soft nylon bristle brush, if necessary. Dry housing using clean, dry, filtered compressed air blast, or allow to stand and air dry.

C. Oil Pressure Regulating Valve

CAUTION: DO NOT EXTEND, CONTRACT, BEND OR OTHERWISE DAMAGE PRESSURE REGULATING VALVE SPRING.

(1) Wash parts in clean petroleum solvent (PWC11-027). If necessary, use a nylon bristle brush to remove contaminants.

(2) Dry parts using clean, dry, filtered compressed air blast, or allow parts to stand and air dry.

9. Inspection/Check

NOTE: For periodic inspection requirements refer to Periodic Inspection table in Chapter 72-00-00.

A. Oil Filter Element

NOTE: Post-SB7476 and Post-SB7581 oil filter elements are not cleanable and are designed to be removed and disposed of at periodic intervals.

(1) Inspect oil filter element for contamination:

(a) Pre-SB7476 oil filter element:

1 If contamination is not evident, clean Pre-SB7476 oil filter element (Ref. Para. 8., following) and inspect, using a strong magnifying glass.

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2 If visible contamination is evident, record amount and physical appearance of debris in engine logbook, collect debris in a clean container, then determine composition of debris in accordance with Subparagraph B., following.

(b) Post-SB7476 or Post-SB7581 oil filter element: if contamination is evident, record amount and physical appearance of debris in engine logbook, collect debris in a clean container, then determine composition of debris in accordance with Subparagraph B., following.

(c) If more than 5% of the visible passages are blocked, establish source of contamination in accordance with Subparagraph B., then clean Pre-SB7476 oil filter element (Ref. Para. 8., Cleaning) or reject and replace Post-SB7476 or Post-SB7581 oil filter element.

(d) If dents or broken wires are found in filter element screen, establish source of contamination in accordance with Subparagraph B.. Inspect oil filter element for damage (Ref. step (2)).

(2) Inspect oil filter element for damage:

(a) If broken wires are found on oil filter element screen, replace oil filter element.

(b) Dents on oil filter element screen are acceptable to a maximum depth of 0.100 inch. Dent(s) must not occupy more than 5% of screen surface area. Replace oil filter element with damage greater than these limits.

B. Determine Composition of Debris

NOTE: Minor metal contamination may occur and appear at first inspection of new engines, or engines recently having completed extensive shop work. In such cases, normal precautions apply.

(1) Classify Debris

(a) Definitions:

Particle: A piece of metal less than 0.010 inch in size.

Chip: A particle larger than 0.010 inch.

Flake: An extremely thin metal chip.

Sliver: Thread-like piece of metal.

Fuzz or Powder: A mass of very fine and light particles.

(b) The following are examples of possible debris contamination:

Non-ferrous metal flakes: these typically originate from bearings or bushings made of aluminum or brass.

Ferrous metal flakes: these typically originate from spalled anti-friction bearings, gear teeth or fretting wear.

Non-metallic flakes: these typically originate from spalled coating inside the oil filter housing or oil tank.

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Steel slivers: these typically originate from interference between steel parts or from heavy scoring.

Powdered material or metallic fuzz: this material is normally plasma coating, and may originate from light air seal rub.

Carbon particles or flakes: this material usually originates from the No. 4 bearing housing.

(2) Carbon Particles

(a) Remove oil pump to access oil strainers located in accessory gearbox (Ref. 72-60-02) and intermediate case (Ref. 72-60-01).

(b) Inspect pressure oil inlet strainer (intermediate case) and scavenge oil strainer (accessory gearbox) for presence of carbon particles or other debris following same procedures as oil filter element (Ref. Subpara. A.). Clean oil strainer element and oil strainer sleeve (Ref. 72-60-01).

(c) Remove emergency fuel shutoff control linkage from No. 4 bearing housing assembly and disassemble No. 4 bearing housing assembly (Ref. 72-50-06).

(d) Clean, inspect and reassemble No. 4 bearing housing components (Ref. 72-50-06). Reinstall emergency fuel shutoff control linkage on bearing housing assembly (Ref. 72-50-06).

(e) Pre-SB7476 engines: clean the engine oil filter element (Ref. Para. 8., Cleaning).

(f) Post-SB7476 or Post-SB7581 engines: remove the oil filter element and install a new Post-SB7476 or Post-SB7581 filter element.

(g) Reinstall all removed components in accordance with chapters referenced above.

(h) Drain, flush and replenish engine oil tank (Ref. 72-00-00, SERVICING).

(3) If three or more metallic flakes or dark, irregularly-sized chips are found in oil filter element, laboratory analysis of the debris and engine oil is required. Proceed as follows:

(a) Perform a spectrographic analysis on debris to determine alloy type (Ref. Subpara. C., following).

NOTE: Material collected at the oil filter and from the pressure oil inlet strainer (inlet case) and scavenge oil strainer (accessory gearbox) should be analyzed separately to aid in isolating source of contamination.

(b) Drain engine oil sample (Ref. 72-00-00, SERVICING) into a clean container and perform spectrometric oil analysis (SOAP) test (Ref. Subpara. C., following).

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(4) If less than 40 small particles of largely non-ferrous metal are discovered, do as follows:

(a) Pre-SB7476 engines: clean the oil filter element (Ref. Para. 8.) and reinstall for continued operation.

(b) Post-SB7476 or Post-SB7581 engines: no debris analysis is required. Remove the oil filter element and install a new Post-SB7476 or Post-SB7581 filter element. Continue engine operation.

(5) White Metal:

(a) On first discovery:

1 Pre-SB7476 engines: clean and reinstall Pre-SB7476 oil filter element (Ref. Para. 8.). Inspect oil filter after 10 hours of engine operation.

2 Post-SB7476 or Post-SB7581 engines: on first discovery, remove and replace Post-SB7476 or Post-SB7581 engine oil filter element. Inspect oil filter after 10 hours of engine operation.

(b) On second discovery of similar amount of metal,

1 Pre-SB7476 engines: on second discovery of similar amount of metal, clean and reinstall Pre-SB7476 oil filter element, then drain and replenish engine oil system with new engine oil (Ref. 72-00-00, SERVICING). Inspect oil filter after 10 hours operation.

2 Post-SB7476 or Post-SB7581 engines: on second discovery of similar amount of metal, remove and replace Post-SB7476 or Post-SB7581 oil filter element, then drain and replenish engine oil system with new engine oil (Ref. 72-00-00, SERVICING). Inspect oil filter after 10 hours of engine operation.

(c) On third discovery of similar white metal, remove and inspect the pressure and scavenge oil check valves for fretting or abnormal wear as a possible source of debris (Ref. 79-20-02, MAINTENANCE PRACTICES).

1 If no fretting wear or abnormal wear is noted during pressure and scavenge oil check valve inspection, remove engine from service and send the engine to a P&WC approved overhaul facility for inspection.

2 If the oil check valves were determined to be unserviceable and have been replaced, clean engine oil filter (Para. 8., Cleaning) and reinstall Pre-SB7476 oil filter element or remove and install new Post-SB7476 or Post-SB7581 oil filter element. Drain and replenish engine oil system (72-00-00, SERVICING). Inspect the oil filter element after 10 hours of operation.

3 If the same amount of white metal is discovered during the check following 10 hours of operation, send the engine to a P&WC approved overhaul facility for further inspection and investigation.

(6) Bronze or Steel:

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(a) On first discovery:

1 Pre-SB7476 engines: clean oil filter element (Ref. Para. 8.), drain residual oil from accessory gearbox into a clean container (Ref. 72-00-00, SERVICING) and visually inspect for unsuspended particles. If drained oil is free of unsuspended particles, proceed to step (c).

2 Post-SB7476 or Post-SB7581 engines: On first discovery, remove and replace Post-SB7476 oil filter element, then drain residual oil from accessory gearbox into a clean container and visually inspect for unsuspended particles (Ref. 72-00-00, SERVICING). If drained oil is free of unsuspended particles, proceed to step (c).

(b) If unsuspended particles are evident, remove oil pump (Ref. 72-60-02) and inspect oil pump scavenge screen in AGB. If particles are evident on scavenge screen, the engine should be shipped to an overhaul facility for inspection. If unsuspended particles are not evident on oil pump scavenge screen, proceed to next step.

(c) Drain and replenish with new engine oil (Ref. 72-00-00, SERVICING), perform ground run (Ref. 71-00-00, ADJUSTMENT/TEST) for one hour and recheck filter.

NOTE: A one hour ground run consists of 3 cycles of 20 minutes. Each cycle consists of 10 minutes at idle speed and 10 minutes at 80% of maximum N1 speed.

(d) If a greater quantity of steel or bronze is found after one hour ground run, the engine should be shipped to an approved overhaul facility for inspection. If a smaller quantity of metal is present:

1 Pre-SB7476 engines: clean oil filter element (Ref. Para. 8.), then inspect it after 5 to 10 hours of engine operation.

2 Post-SB7476 or Post-SB7581 engines: replace existing Post-SB7476 filter with a new filter, then inspect it after 5 to 10 hours of engine operation.

(e) If recheck after 5 to 10 hours operation reveals presence of a similar quantity of steel or bronze, the engine should be returned to an approved overhaul facility for inspection.

(7) Debris analysis must be done by a qualified laboratory. Refer to Service Information Letter No. GEN-123 for list of laboratories qualified for engine oil analysis.

NOTE: DELETED.

C. Laboratory Inspection of Metallic Debris

(1) Laboratory Spectrographic Analysis of Metallic Debris

(a) Analyze debris collected from main oil filter element and the pressure oil inlet strainer (inlet case) and the oil scavenge strainer (accessory gearbox) by spectrograph for presence of the following materials:

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Material	Possible Source
AMS6444 (52100)	Bearing ball and/or race material.
AMS6491 (M-50)	Bearing ball, bearing roller and/or race material.
AMS6414 (4340)	Bearing cage.
AMS6415 (4340)	Bearing cage.
AMS5646 (30347)	No. 2 bearing keywasher.
AMS5510 (30321)	AGB driveshaft upper or lower bearing keywasher.
AMS6260 (9310)	Gear
AMS6265 (9310)	Gear

(b) Proceed as follows after spectrographic analysis:

NOTE: Minor metal contamination may occur and appear at first inspection of new engines, or engines recently having completed extensive shop work. In such cases, normal precautions apply.

1 If bearing or keywasher material is found, contact your P&WC field service representative or the 24 hour CFirst Customer Help Desk for further instructions.

2 If gear material is found, ensure procedures at Paragraph 9.B., step (6) are completed.

D. Laboratory Inspection of Engine Oil Sample

(1) General - Spectrometric oil analysis is used to analyze engine oil samples for the presence of designated elements, measured in parts per million (ppm). Engine component wear may be indicated by the presence in oil samples of high concentrations of some combinations of these designated metals. By permitting the observation of engine oil metallic concentrations and trends, SOAP analysis helps detect engine component distress.

(2) Factors affecting Test Results

(a) Laboratories or technicians: oil sample SOAP results may vary if different laboratories or technicians perform tests.

(b) Ambient conditions: test results may reflect the ambient conditions in which the engine was operated. For example, an oil sample taken from an engine having operated in a maritime environment may contain a high salt content, therefore a higher sodium (Na) content.

(c) Sampling intervals and sample drainage locations: random oil sampling intervals or changing engine oil sample drainage location affects test results and makes trend monitoring very difficult.

(3) SOAP Method

(a) SOAP tests shall be analyzed using the atomic emission method.

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(b) The atomic emission method is used by Raytheon Aircraft Co. and by Pratt & Whitney Canada Inc. chemical laboratories. The atomic emission method is known to produce very accurate results and may be completed using the Inductively Coupled Plasma (ICP) method or the ignition method.

(c) It is recommended that engine oil SOAP samples are taken: after the engine has run for at least 30 minutes; within ten minutes of engine shutdown; prior to the addition of any new engine oil.

(d) It is recommended that engine oil SOAP samples be consistently taken from the same location on the engine. It is recommended that oil samples be drained consistently from either the AGB or the oil pump drain locations (Ref. 72-00-00, SERVICING).

(e) It is recommended that engine oil SOAP samples be consistently taken at regular intervals and tested at the same laboratory.

(f) It is recommended that engine oil acidity levels be measured at regular intervals. Refer to step (4) for allowable engine oil acidity levels.

(g) Refer to Table 201 for allowable SOAP ranges and recommendations. These limits are based on initial data and will be reviewed as more information becomes available.

TABLE 201, Engine Oil Soap Limits in Parts per Million (ppm)

Element	Normal Range (See NOTE 1.)	Marginal Range (See NOTE 1.)	High Range (See NOTE 2.)	Abnormal Range (See NOTE 2.)	Abnormal Trend (ppm increase in 25 hours) (See NOTE 3.)
Ag (Silver)	0 to 3	between 4 and 5	6	>7	3
Al (Aluminium)	0 to 6	between 7 and 10	11	>12	4
B (Boron)	0 to 4	between 5 and 6	7	>8	2
Cu (Copper)	0 to 3	between 4 and 5	6 to 8	>9	3
Cr (Chromium)	0 to 3	between 4 and 6	7 to 8	>9	3
Fe (Iron)	0 to 5	between 6 and 8	9 to 11	>12	3
Mg (Magnesium)	0 to 7	between 8 and 10	11 to 14	>15	6
Mo (Molybdenum)	0 to 5	between 6 and 7	8 to 11	>12	3

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TABLE 201, Engine Oil Soap Limits in Parts per Million (ppm) (Cont'd)

Element	Normal Range (See NOTE 1.)	Marginal Range (See NOTE 1.)	High Range (See NOTE 2.)	Abnormal Range (See NOTE 2.)	Abnormal Trend (ppm increase in 25 hours) (See NOTE 3.)
Na (Sodium)	0 to 8	between 9 and 10	11	>12	2
Ni (Nickel)	0 to 6	between 7 and 9	10 to 15	>16	6
Pb (Lead)	0 to 3	between 4 and 5	6	>7	2
Si (Silicon)	0 to 27	28 to 30	31 to 34	>35	10
Sn (Tin)	0 to 19	20 to 22	23 to 24	>25	4
Ti (Titanium)	0 to 5	6	7	>8	2
Zn (Zinc)	0 to 4	between 5 and 6	6	>7	2
NOTE: 1. See step D.(5) for recommended maintenance action.					
NOTE: 2. See step D.(6) for recommended maintenance action.					
NOTE: 3. See step D.(8) for recommended maintenance action.					
NOTE: 4. Data for Be (Berylium), CD (Cadmium), Co (Cobalt), Mn (Manganese) and V (Vanadium) are currently too limited for inclusion on table.					

(4) Engine Oil Acidity

(a) The range for allowable engine oil acidity is a result indicating a total acid number between 0 and 2.0.

NOTE: The total acid number is the number of milligrams of potassium hydroxide per gram of engine oil required to neutralize the oil sample acidity.

(5) Maintenance Action - NORMAL or MARGINAL range (Ref. Table 201): continue engine in service and maintain normal SOAP sampling schedule.

(6) Maintenance Action - HIGH or ABNORMAL range (Ref. Table 201):

NOTE: In order to ensure consistency of oil samples taken while trending results are in the High to Abnormal range, cancel all scheduled engine oil changes for a period of up to 100 flight hours.

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(a) Check oil filter element for blockage (Ref. Subpara.9.A.). Collect and analyze visible metal and any other visible debris. If engine is serviceable, continue in service.

(b) Perform the following after the shortest of the following intervals: between one and three hours of operation maximum since the initial sample, or after next flight:

1 Drain and analyze a second engine oil sample (Ref. 72-00-00, SERVICING).

2 Inspect engine oil filter element and determine serviceability of engine (Ref. Subpara. 9.A.). If serviceable, continue operating engine.

3 If analysis of the second oil sample indicates the presence of elements in MARGINAL or NORMAL ranges, continue engine in service and maintain normal SOAP sampling schedule.

4 If analysis of the second oil sample indicates the presence of elements in HIGH or ABNORMAL ranges, continue engine in service and refer to revised SOAP sample interval and maintenance action in step (7).

(7) Revised SOAP sample interval and maintenance action for second SOAP sample test results indicating an abnormal trend or the presence of elements in HIGH or ABNORMAL range:

NOTE: In order to ensure consistency of oil samples taken while trending results are in the High to Abnormal range, cancel all scheduled engine oil changes for a period of up to 100 flight hours.

(a) Drain and analyze a third engine oil sample after the shortest of the following intervals: between one and three hours of operation maximum since the initial sample, or after next flight (Ref. 72-00-00, SERVICING).

(b) Inspect engine oil filter element and determine serviceability of engine (Ref. Subpara. 9.A.). If serviceable, continue operating engine.

(c) If analysis of the third oil sample indicates the presence of elements in MARGINAL or NORMAL ranges, continue engine in service and return to normal SOAP sampling schedule.

(d) If analysis of the third oil sample indicates the presence of elements in HIGH or ABNORMAL ranges, refer to Table 202 and inspect engine components indicated by high or abnormal element count.

(8) Maintenance Action - ABNORMAL TREND (Ref. Table 201):

NOTE: In order to ensure consistency of oil samples taken while trending results indicate an abnormal trend, cancel all scheduled engine oil changes for a period of up to 100 flight hours.

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(a) Regardless of the current oil sampling interval, if a sudden trend increase of any element occurs that is equal to or greater than the value specified on Table 201 'Abnormal Trend' column, then perform a second sample prior to next flight to confirm the abnormal trend.

(b) If the second sample taken prior to the next flight indicates a return to typical normal readings, then return engine to service and resume normal engine oil SOAP sampling schedule.

(c) If the second sample taken prior to the next flight indicates a result which continues to fall within Table 201 'Abnormal Trend' column, return engine to service and perform maintenance actions in step D.(7).

TABLE 202, Selected Engine Components and Composition

Element Composition	Engine Component(s): Bearings and Gears
Main elements: Chromium, Copper, Iron, Manganese, Nickel and Silicon.	No. 1 brg., No. 2 brg., AGB driveshaft upper and lower bearings, and associated races
Main elements: Cobalt, Chromium, Iron, Manganese, Molybdenum, Nickel, Silicon and Vanadium.	No. 3 brg. , No. 3 ½ brg. and No. 4 brg. rollers
Main elements: Chromium, Copper, Iron, Manganese, Molybdenum, Nickel, Silicon; trace amounts of Silver.	No. 3 brg. , No. 3 ½ brg. and No. 4 brg. bearing cages
Main elements are Chromium, Copper, Iron, Manganese, Molybdenum, Nickel and Silicon.	Accessory gearbox and oil pump gears
Main elements: Chromium, Manganese, Nickel, Silicon; trace amounts of Aluminum and Tin.	No. 4 Bearing air seal (on LPT rotor)

10. Fits, Clearances and Torque Loadings

A. General

Refer to Tables 203, 204, 205, 206, and to Figure 204.

TABLE 203, Fits and Clearances

REF. NO.	Name	Dim. for Ref. (inches)		Limits (inches)		
		Min.	Max.	Min.	Max.	Replace
1146	Valve, Pressure Regulating	0.8502	0.8507	0.0003	0.0016	
	Sleeve, Pressure Regulating Valve	0.8510	0.8518			

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TABLE 203, Fits and Clearances (Cont'd)

REF. NO.	Name	Dim. for Ref. (inches) Min.	Dim. for Ref. (inches) Max.	Limits (inches) Min.	Limits (inches) Max.	Limits (inches) Replace
1147	Valve, Pressure Regulating	0.8502	0.8507	0.0003	0.0016	
	Sleeve, Pressure Regulating Valve	0.8510	0.8618			
1150	Sleeve, Oil Filler Housing	0.9896	0.9900	0.0005T	0.0020T	
	Housing, Oil Filler	0.9880	0.9891			
1151	Valve, Oil Filter Bypass	0.6400	0.6410	0.0010	0.0030	
	Housing, Oil Filter	0.6420	0.6430			

TABLE 204, Torque and Stretch

REF. NO.	Name	Limits Min.	Limits Max.
1715	Oil Filter Housing Plate Retaining Screw	10 lb.in.	15 lb.in.

TABLE 205, Spring Pressure

REF. NO.	Name	Limits Min.	Limits Max.
1802	Spring, Pressure Regulating Valve		
	At length 2.453	29 lb. 13 oz.	31 lb. 5 oz.
	At length 3.800	9 lb. 12 oz.	11 lb. 4 oz.
1803	Spring, Oil Filter Bypass Valve		
	At length 0.900	3 lb. 10.54 oz.	3 lb. 13.46 oz.
	At length 0.739	2 lb. 5.07 oz.	5 lb. 10.93 oz.

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TABLE 206, Special Assembly

REF. NO.	Name	Limits Min.	Limits Max.
1920	Lapping of Oil Filter Bypass Valve		
	(1) Lap face of oil filter bypass valve to obtain 360 degrees contact.		

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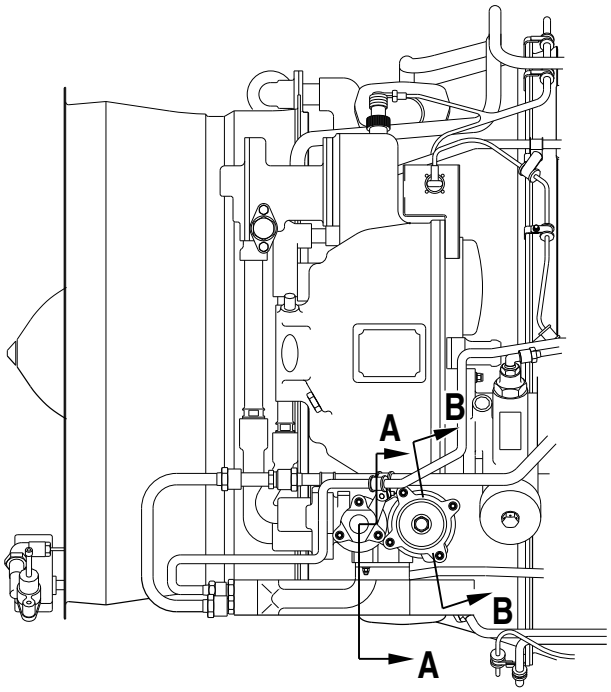
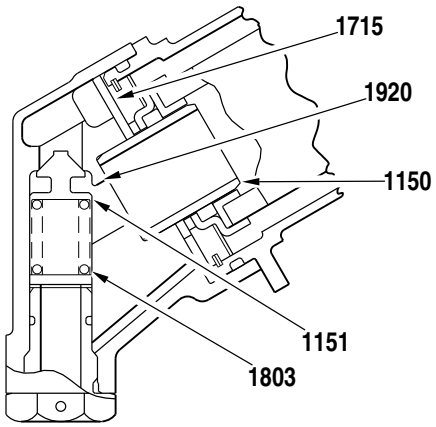
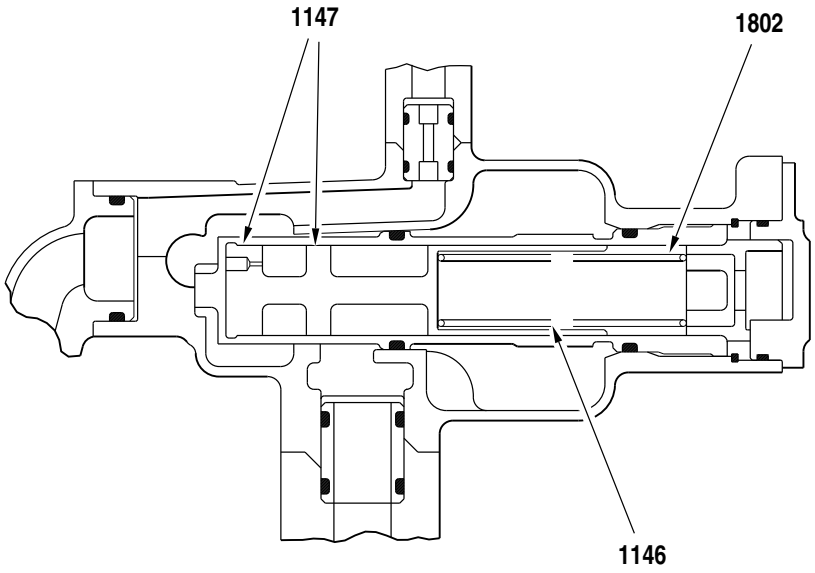




SECTION A–A



SECTION B–B

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Fits, Clearances and Torque Loadings
Figure 204

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CHECK VALVES AND TUBES (JT15D-5) - DESCRIPTION AND OPERATION

1. Check Valves

The engine oil system contains two check valve assemblies, one each in the pressure and scavenge oil lines. Each check valve assembly is comprised of a housing, a check valve, a helical compression spring and spring seat, preformed packings and a retaining ring to secure the parts.

The assembled check valves are installed in the oil filter housing in the pressure and scavenge line ports. Pressure and scavenge oil is fed to and from the oil pump via transfer tubes and a coupling which secures to the oil filter housing.

The two check valves are held normally open by the operating pressure in the oil system. When the engine is not running, gravitational oil pressure against the check valve face compresses the spring and the check valve closes under the load. This allows oil system components, such as the oil filter and external transfer tubes downstream of the check valves, to be removed for servicing without draining the oil tank.

CHECK VALVES AND TUBES (JT15D-5) - MAINTENANCE PRACTICES

1. General

   A. The following describes and removal and installation procedures for the check valves, check valve coupling and transfer tubes.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Engine Lubricating Oil

3. Special Tools

   The special tools listed below are used in the following procedures.

Tool No.	Name
PWC31680	Puller

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal of Check Valves (Ref. Fig. 201)

      (1) Drain oil tank (Ref. 72-00-00, SERVICING).

      (2) Remove two retaining rings (3) and (6) securing oil transfer tubes (2) and (5) to coupling assembly (7). Push tubes into coupling, ensuring that they are removed from ports on oil pump.

      (3) Remove three self-locking nuts (9) and washers (8) securing coupling assembly (7) to oil filter housing assembly (16) and remove transfer tubes and coupling.

      (4) Remove oil transfer tubes (2) and (5) from coupling assembly (7) and preformed packings (1) and (4) from each end of transfer tubes. Discard preformed packings.

      (5) Remove check valve assemblies from oil filter housing assembly (16) using puller (PWC31680).

      (6) Compress springs (12), remove retaining rings (10) and spring seats (11). Separate check valves (13) from check valve housings (14). Remove and discard all preformed packings.

      (7) Keep check valve assemblies in separate sets. Do not mix parts from different assemblies.

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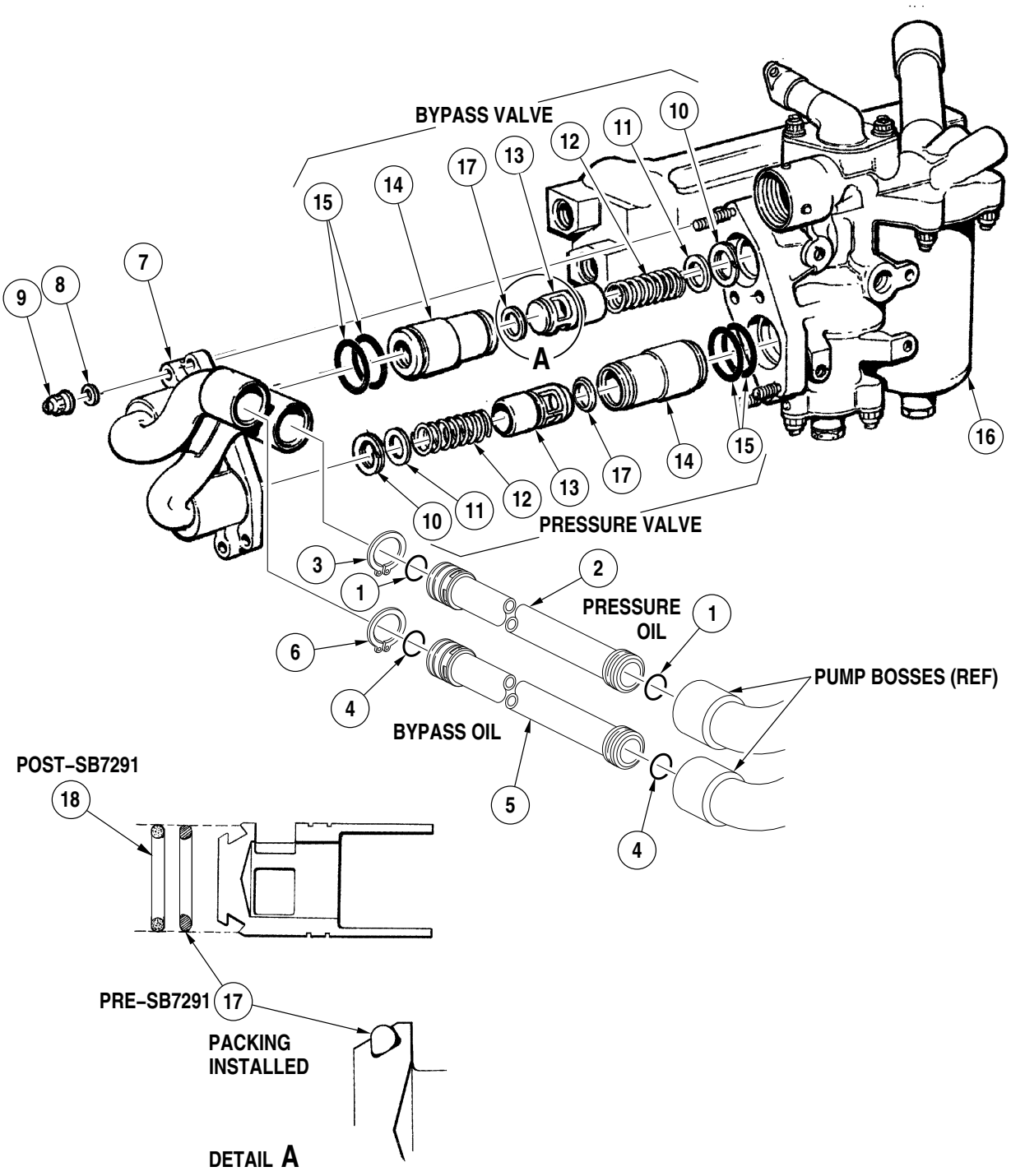

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Removal/Installation - Oil Check Valves
Figure 201

Key to Figure 201

1. Preformed Packing
2. Oil Transfer Tube
3. Retaining Ring
4. Preformed Packing
5. Oil Transfer Tube
6. Retaining Ring
7. Coupling Assembly
8. Washer
9. Self-locking Nut
10. Retaining Ring
11. Spring Seat
12. Spring
13. Check Valve
14. Check Valve Housing
15. Preformed Packing
16. Oil Filter Housing Assembly
17. Preformed Packing (Pre-SB7291)
18. Preformed Packing (Post-SB7291)

B. Installation of Check Valves (Ref. Fig. 201)

(1) Pre-SB7291 engines: install new preformed packings (17) in groove of check valves (13), ensuring that flat side of packing is toward small end of check valve and that the packing minor diameter seats in the minor diameter of the check valve groove (Ref. View B).

(2) Post-SB7291 engines: install new preformed packings (18) in grooves of check valves (13).

CAUTION: TO ENSURE PRESSURE OIL TO, AND BYPASS OIL FROM THE OIL FILTER, INSTALL VALVES AS SHOWN ON FIGURE 201.

(3) Insert check valves (13) into respective check valve housings (14) and install spring seats (11). Compress springs (12) and secure in valves with retaining rings (10).

(4) Carry out static oil leak test on both check valve assemblies as follows (Ref. Fig. 202):

(a) Install assembled check valve in locally fabricated tool. Secure check valve in clear plastic tube with hose clamp. Fill tube with engine oil (Ref. SB7001) to a level two inches above check valve. Prime check valve to release trapped air. Remove residual oil and ensure no oil leak from check valve. Fill tube with engine oil to a level 16 inches above check valve. Let check valve assembly remain under static oil leak test for two hours minimum. No oil leakage is permitted.

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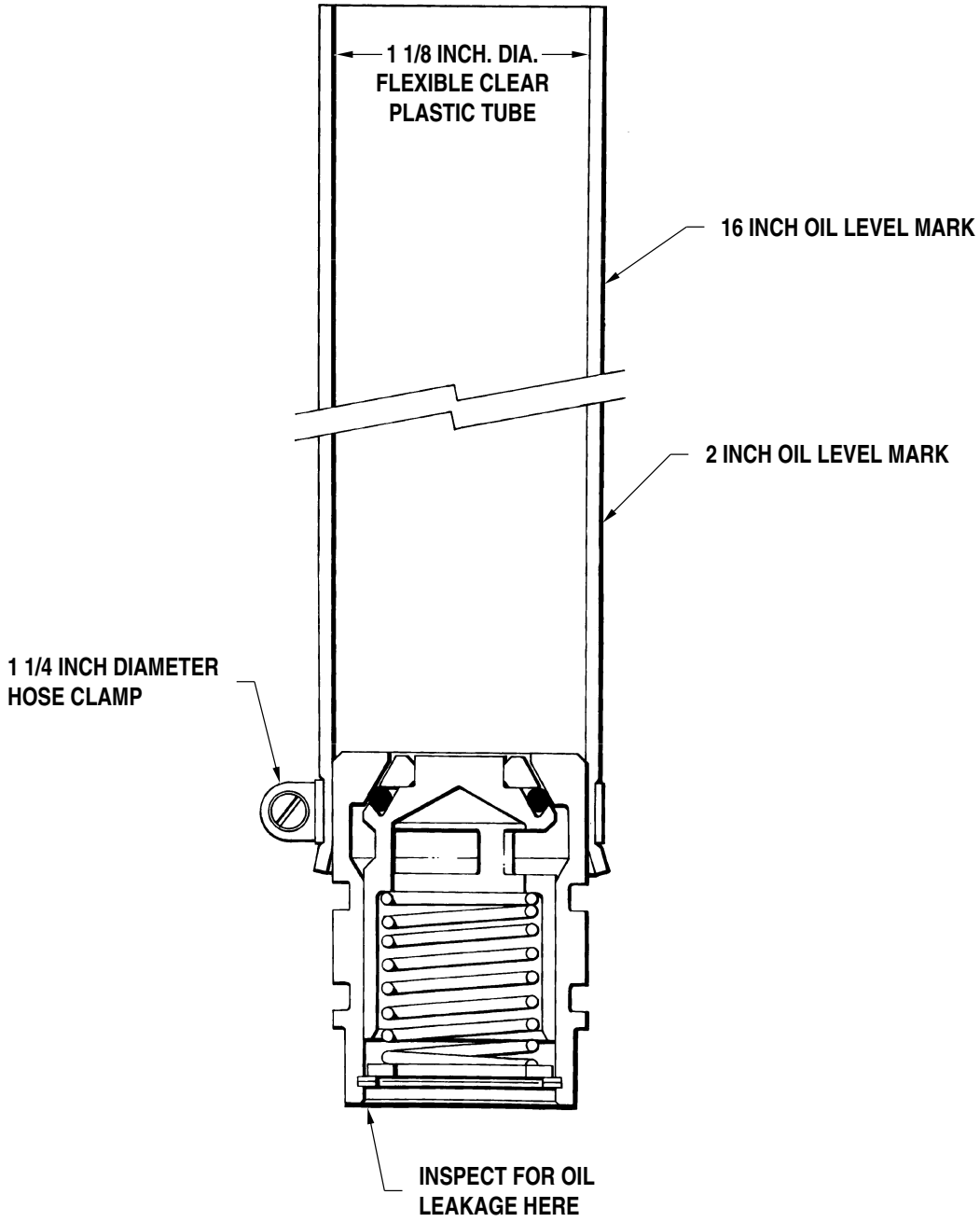

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Static Oil Leak Test
Figure 202

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(b) If check valve assembly fails test, disassemble check valve (Ref. Subpara. 5.A.), discard preformed packing, and clean and inspect seats of check valve housing ((14), Fig. 201) and check valve (13). If no defects found, install new preformed packing on check valve and reassemble (Ref. Subpara. 5.B.).

(c) Repeat static oil leak test (Ref. step (b)). Reject check valve assembly if check valve assembly fails second leak test.

(5) Install Check Valve and Valve Housing as follows:

(a) Install two new preformed packings (15) on each check valve housing.

(b) Install check valve assemblies in ports of oil filter housing assembly (16).

(c) Install new preformed packings (1), (4) on ends of oil transfer tubes (2), (5). Insert and push oil transfer tubes into coupling assembly (7).

(d) Install coupling assembly (7) together with oil transfer tubes over check valve assemblies, and secure coupling to oil filter housing assembly (16), using washers (8) and self-locking nuts (9). Tighten and torque nuts 32 to 36 lb.in.

(e) Lightly pull oil transfer tubes from coupling assembly and insert into oil pump bosses; secure with retaining rings (3), (6).

(f) Refill oil tank (Ref. 72-00-00, SERVICING).

6. Fits, Clearances and Torque Loadings

A. Refer to Tables 201 and 203, and to Figure 203.

TABLE 201, FITS AND CLEARANCES

REF. NO.	Name	Dim. for Ref. (inches)		Limits (inches)		
		Min.	Max.	Min.	Max.	Replace
1149	Valve, Oil Check	0.8710	0.8725	0.0015	0.0050	0.005
	Housing, Check Valve	0.8740	0.8760			

TABLE 202, TORQUE AND STRETCH

REF. NO.	Name	Limits	
		Min.	Max.
Not Applicable			

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TABLE 203, SPRING PRESSURE

REF. NO.	Name	Limits Min.	Limits Max.
1804	Spring, Oil Check Valve		
	At length 0.854	1 lb. 6.0 oz.	1 lb. 8.0 oz.
	At length 0.665	2 lb. 0 oz.	2 lb. 4 oz.

TABLE 204, SPECIAL ASSEMBLY

REF. NO.	Name	Limits Min.	Limits Max.
	Not Applicable		

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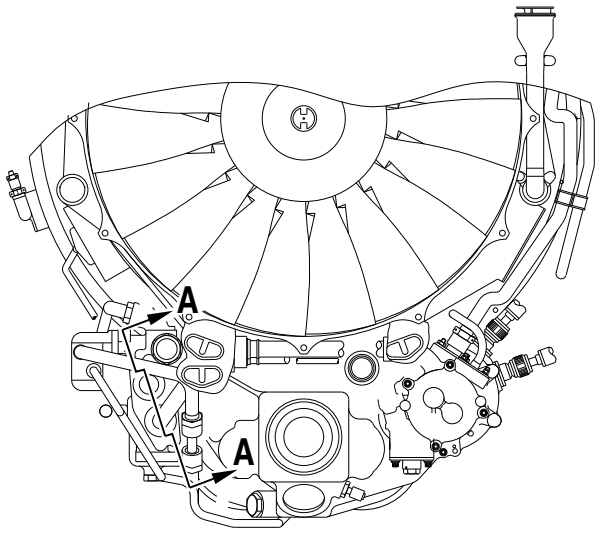

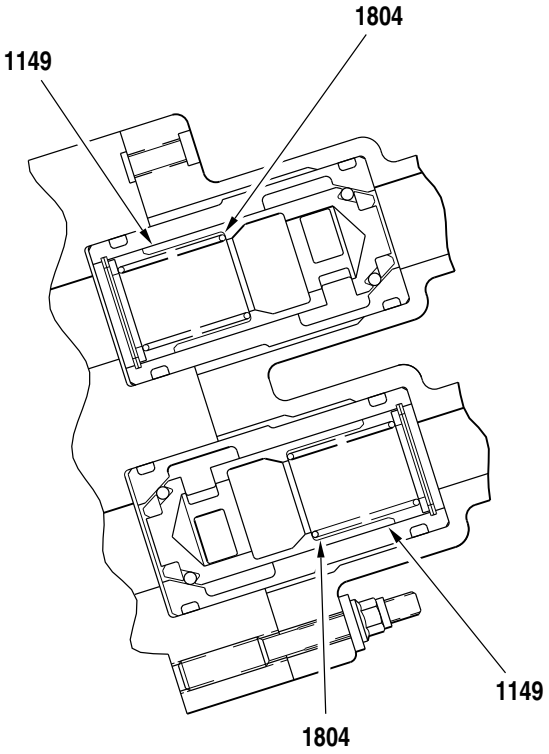

SECTION **A–A**

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Fits, Clearances and Torque Loadings
Figure 203

EXTERNAL PRESSURE OIL TUBES (JT15D-5) - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the external pressure oil tubes.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Engine Lubricating Oil
PWC05-061	Crocus Cloth
PWC11-021	Carbon Remover Compound
PWC11-027	Petroleum Solvent

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal of No. 1, 2, 3 and 4 Bearings Pressure Oil Tubes (Ref. Fig. 201)

      (1) Remove lockwire and disconnect coupling on tube (8) at tee union of pressure oil tube (5).

      (2) Remove self-locking nut (6) and bolt (12) securing two loop clamps (7).

      (3) Remove self-locking nut (20) and bolt (19) securing loop clamps (15) and (17).

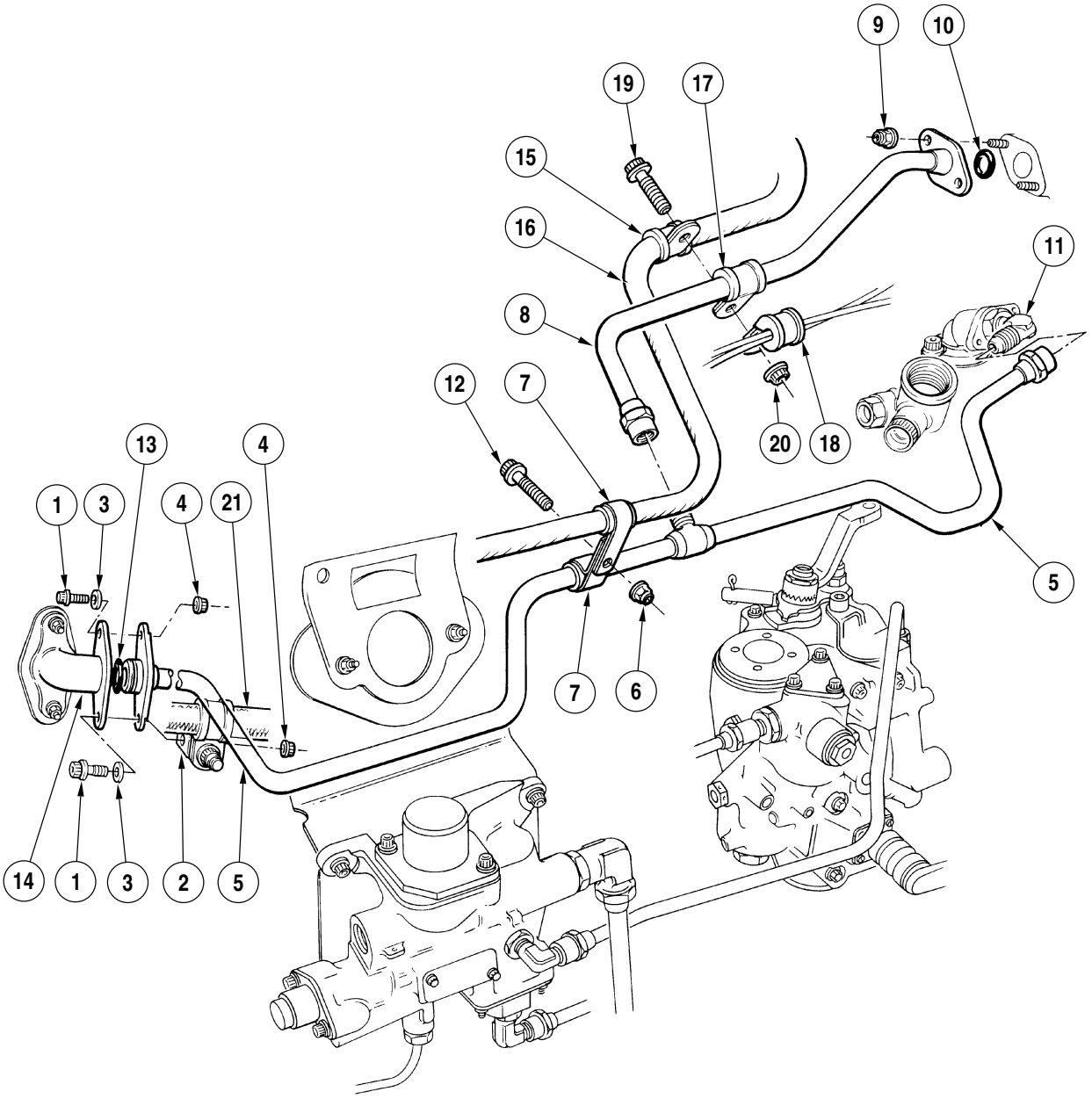
      (4) Remove two self-locking nuts (4), washers (3), bolts (1) and bracket (2) securing tube (5) to elbow (14) at 5 o'clock position on rear of bypass duct.

      (5) Disconnect coupling nut on No.4 bearing pressure oil tube (5) from elbow (11) on oil filter housing.

      (6) Remove No.4 bearing pressure oil tube (5) and preformed packing (13). Discard preformed packing.

      (7) Remove two self-locking nuts (9) securing oil tube (8) to intermediate case.

      (8) Remove oil tube (8) with preformed packing (10). Remove and discard preformed packing.



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Removal/Installation - No 1, 2, 3 and 4 Bearings Pressure Oil Tubes
Figure 201

Key to Figure 201

1. Bolt
2. Bracket
3. Washer
4. Self-locking Nut
5. No.4 Bearing Pressure Oil Tube
6. Self-locking Nut
7. Double Loop Clamp Assembly
8. Nos.1, 2, 3 Bearings Pressure Oil Tube
9. Self-locking Nut
10. Preformed Packing
11. Elbow
12. Bolt
13. Preformed Packing
14. Elbow
15. Loop Clamp
16. T6 Thermocouple Wiring Harness
17. Loop Clamp
18. Loop Clamp
19. Bolt
20. Self-locking Nut
21. Ignition Exciter Cable

B. Installation of No. 1, 2, 3 and 4 Bearings Pressure Oil Tubes (Ref. Fig. 201)

(1) Install new preformed packing (13) on rear flange of No.4 bearing pressure oil tube (5) and install two loop clamps (7).

(2) Mate rear flange of tube (5) with flange on elbow (14) and connect tube forward coupling nut to elbow (11).

(3) Secure rear flange on tube (5) and angle bracket (2) at inner hole to elbow (14) with two bolts (1), washers (3) and self-locking nuts (4). Torque nuts 32 to 36 lb.in.

(4) Secure front end of No.4 bearing pressure oil tube (5) to elbow (11) on oil filter housing. Torque coupling nut on tube (5) at elbow (11) lb.in. and lockwire.

(5) Torque coupling nut on tube (5) at elbow (11) 270 to 300 lb.in. and lockwire.

(6) Install new preformed packing (10) on oil tube (8). Mount flanged end of tube on intermediate case studs, and connect coupling nut onto tube (5) coupling. Install two self-locking nuts (9) and torque 32 to 36 lb.in.

(7) Torque coupling nut on tube (8) at tee connection 270 to 300 lb.in. and lockwire.

(8) Secure two loop clamps (7) with bolt (12) and self-locking nut (6). Torque nut 32 to 36 lb.in.

(9) Secure loop clamps (15) and (17) and with bolt (12) self-locking nut (6). Torque nut 32 to 36 lb.in.

6. Inspection/Check

A. Procedure

(1) Inspect tube visually for damage as follows:

(a) Cracks - Cracked tube must be replaced. No repair is permitted.

(b) Scratches - Minor scratches having no appreciable depth are acceptable. Scratches to a depth of 0.005 inch must be blended out. Replace tube with scratches over 0.005 inch deep.

(c) Nicks - Individual nicks up to 0.062 inch long by 0.010 inch wide and 0.003 inch deep can be ignored. Nicks to a maximum depth of 0.005 inch must be blended out to remove sharp edges. Replace tubing with nicks greater than 0.005 inch deep.

(d) Dents - Round bottom dents on straight sections of tube are permitted provided the length and depth are not greater than 10 percent of the normal outside diameter of tube. No more than one dent to maximum depth per 12 inch length of tube is acceptable. Dents on tube bends, which cause restriction by flattening and local weakening, are not acceptable.

(e) Pitting - Minor isolated pitting up to 0.003 inch deep is acceptable. Clusters of pitting should be blended out to a maximum depth of 0.005 inch. Tubing must be replaced if pitting exceeds 0.005 inch deep.

(f) Corrosion - Staining on tube and surface corrosion is acceptable if removable by light polishing with crocus cloth (PWC05-061)and oil (PWC03-001).

7. Cleaning/Painting

A. Procedure

(1) Clean tubing as follows:

(a) Soak external oil tubing in cold carbon remover (PWC11-021) for two hours at room temperature.

(b) Rinse tube exterior with petroleum solvent (PWC11-027).

(c) Pressure flush tube interior with petroleum solvent and dry interior and exterior with compressed air.

EXTERNAL SCAVENGE OIL TUBES (JT15D-5) - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the external scavenge oil tubes.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC05-061	Crocus Cloth
PWC03-001	Engine Lubricating Oil
PWC11-021	Carbon Remover Compound
PWC11-027	Petroleum Solvent

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal of No. 4 Bearing Oil Scavenge and Oil Return-to-Tank Tubes (Ref. Fig. 201)

      (1) Detail A: remove self-locking nut (18) and bolt (14) securing loop clamp (15) to anti-icing tube loop clamp (17) on anti-icing air delivery tube.

      (2) Remove lockwire and disconnect coupling nut (4) on oil-to-tank tube (3) from adapter (5) on oil pump.

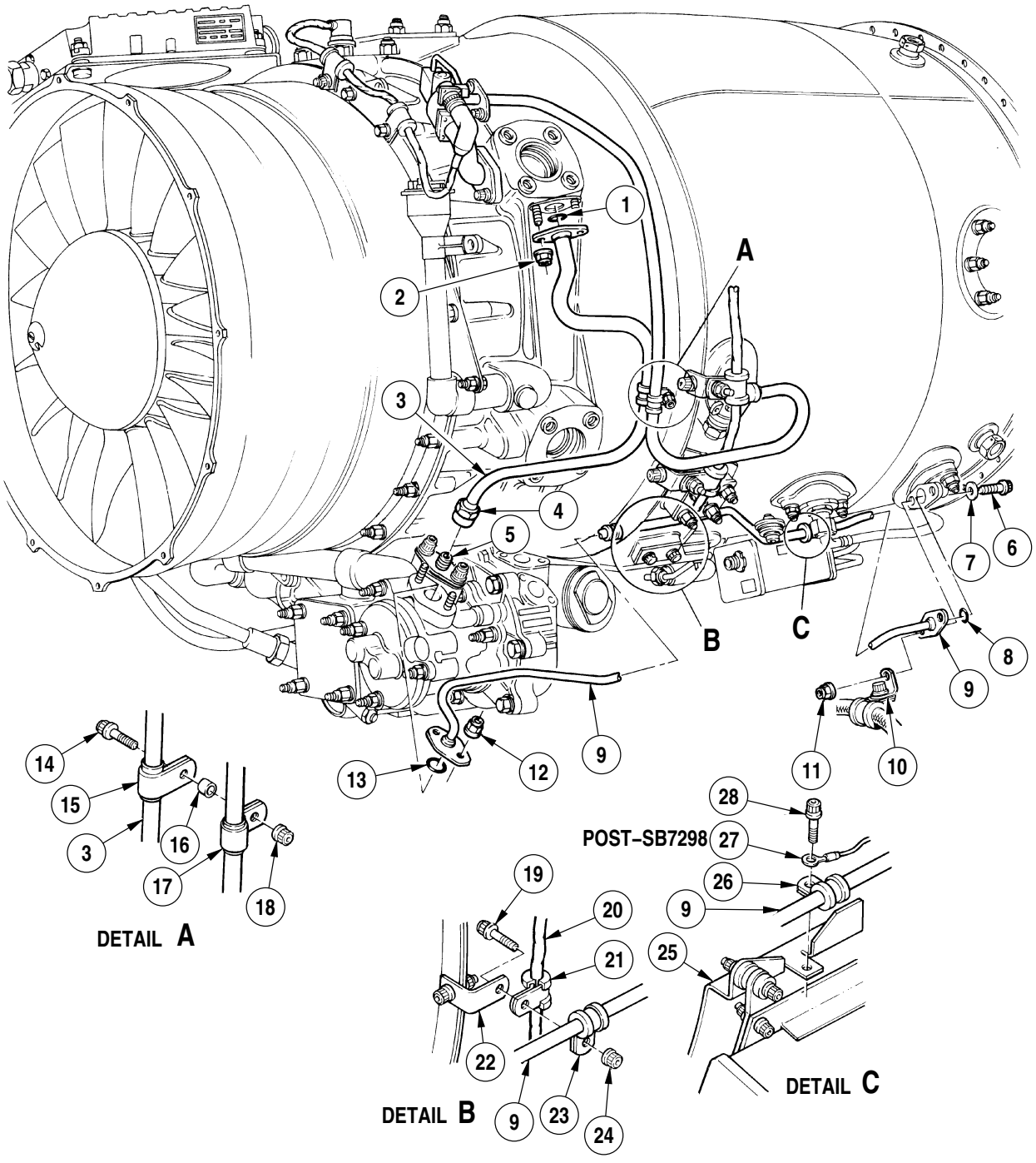
      (3) Remove two self-locking nuts (2) securing flanged end of oil-to-tank tube (3) to intermediate case. Remove tube and discard packing. Remove loop clamp (15) from tube.

      (4) Detail B: remove self-locking nuts (24) and bolt (19) securing loop clamps (23) and (21) to angle bracket (22).

      (5) Detail C: for Pre-SB7298 engines, remove bolt (28) securing loop clamp (26) on scavenge oil tube (9) to ignition exciter bracket (25). For Post-SB7298 engines, also remove ground terminal (27).

      (6) Remove two self-locking nuts (12) securing flanged end of No. 4 bearing scavenge oil tube (9) to oil pump.

      (7) Remove two self-locking nuts (11), bolts (6) and washers (7) securing No. 4 bearing scavenge oil tube assembly (9) and angle bracket (10) to flanged elbow at rear of bypass duct.



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Removal/Installation - Oil Scavenge and Return-to-Tank Tubes
Figure 201

Key to Figure 201

1. Preformed Packing
2. Self-locking Nut
3. Oil Tube - Return to Tank
4. Tube Coupling Nut
5. Adapter
6. Bolt
7. Washer
8. Preformed Packing
9. No.4 Bearing Oil Scavenge Tube
10. Angle Bracket
11. Self-locking Nut
12. Self-locking Nut
13. Preformed Packing
14. Bolt
15. Loop Clamp
16. Spacer
17. Loop Clamp
18. Self-locking Nut
19. Bolt
20. Engine Wiring Harness
21. Loop Clamp Assembly
22. Angle Bracket
23. Loop Clamp
24. Self-locking Nut
25. Ignition Exciter Mount Bracket
26. Loop Clamp
27. Ground Terminal Assembly (Post-SB7298)
28. Bolt

(8) Remove tube (9) and two preformed packings (8) and (13). Discard preformed packings. Remove two loop clamps (23) and (26) from tube.

B. Installation of No. 4 Bearing Oil Scavenge and Oil Return-to-Tank Tubes (Ref. Fig. 201)

(1) Install two new preformed packings (8) and (13) and to loop clamps (23) and (26) on No.4 bearing scavenge oil tube (9).

(2) Secure No.4 bearing scavenge oil tube as follows:

(a) Secure front flange of tube (9) to studs on oil pump mounting boss with two self-locking nuts (12). Tighten but do not torque nuts.

(b) Secure rear flange of tube (9) with angle bracket (10) to flanged elbow with two washers (7), bolts (6) and self-locking nuts (11).

(c) Torque nuts (11) and (12) to 32 to 36 lb.in.

(3) Detail C: for Pre-SB7298 engines, secure loop clamp (26) to ignition exciter mounting bracket with bolt (28) . For Post-SB7298 engines, secure ground terminal (27) and loop clamp (26) to ignition exciter mounting bracket with bolt (28). Torque bolt 32 to 36 lb.in.

(4) Detail B: secure loop clamps (21) and (23) to angle bracket (22) on flange B with bolt (19) and self-locking nut (24). Tighten and torque nut to 32 to 36 lb.in.

(5) Detail A: install loop clamp assembly (15) on oil return-to-tank tube (3).

(6) Install preformed packing (1) on oil-to-tank tube (3) and install tube as follows:

(a) Secure flanged end of tube (3) to intermediate case studs with two self-locking nuts (2). Tighten but do not torque nuts.

(b) Connect coupling nut (4) on tube (3) to adapter (5) on oil pump.

(c) Torque self-locking nuts (2) to 32 to 36 lb.in.

(d) Torque coupling nut (4) to 450 to 500 lb.in.

(7) Detail A: secure loop clamps (15) and (17) and spacer (16) with bolt (14) and self-locking nut (18). Tighten and torque nut to 32 to 36 lb.in.

6. Inspection/Check

A. Procedure

(1) Inspect tube visually for damage as follows:

(a) Cracks - Cracked tube must be replaced. No repair is permitted.

(b) Scratches - Minor scratches having no appreciable depth are acceptable. Scratches to a depth of 0.005 inch must be blended out. Replace tube with scratches over 0.005 inch deep.

(c) Nicks - Individual nicks up to 0.062 inch long by 0.010 inch wide and 0.003 inch deep can be ignored. Nicks to a maximum depth of 0.005 inch must be blended out to remove sharp edges. Replace tubing with nicks greater than 0.005 inch deep.

(d) Dents - Round bottom dents on straight sections of tube are permitted provided the length and depth are not greater than 10 percent of the normal outside diameter of tube. No more than one dent to maximum depth per 12 inch length of tube is acceptable. Dents on tube bends, which cause restriction by flattening and local weakening, are not acceptable.

(e) Pitting - Minor isolated pitting up to 0.003 inch deep is acceptable. Clusters of pitting should be blended out to a maximum depth of 0.005 inch. Tubing must be replaced if pitting exceeds 0.005 inch deep.

(f) Corrosion - Staining on tube and surface corrosion is acceptable if removable by light polishing with crocus cloth (PWC03-001) and oil (PWC05-061).

7. Cleaning/Painting

A. Procedure

(1) Clean tubing as follows:

(a) Soak external oil tubing in cold carbon remover (PWC11-021) for two hours at room temperature.

(b) Rinse tube exterior with petroleum solvent (PWC11-027).

(c) Pressure flush tube interior with petroleum solvent and dry interior and exterior with compressed air.

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
LEP	1	Nov 07/2008
	2 blank	Nov 07/2008
Contents	1	Nov 07/2008
	2	Nov 07/2008
	3	Nov 07/2008
	4	Nov 07/2008
79-21-00	1	Oct 06/2006
Description and	2	Oct 06/2006
Operation	3	Oct 06/2006
	4 blank	Oct 06/2006
79-21-01	1	Oct 06/2006
Description and	2 blank	Oct 06/2006
Operation		
79-21-01	201	Nov 07/2008
Maintenance	202	Nov 07/2008
Practices	203	Nov 07/2008
	204	Nov 07/2008
	205	Nov 07/2008
	206	Nov 07/2008
	207	Nov 07/2008
	208	Nov 07/2008
	209	Nov 07/2008
	210	Nov 07/2008
	211	Nov 07/2008
	212	Nov 07/2008
	213	Nov 07/2008
	214	Nov 07/2008
	215	Nov 07/2008
	216	Nov 07/2008
	217	Nov 07/2008
	218	Nov 07/2008
	219	Nov 07/2008
	220	Nov 07/2008
	221	Nov 07/2008
	222	Nov 07/2008
	223	Nov 07/2008
	224	Nov 07/2008
	225	Nov 07/2008
	226	Nov 07/2008
79-21-02	1	Oct 06/2006
Description and	2 blank	Oct 06/2006
Operation		
79-21-02	201	Oct 06/2006
Maintenance	202	Oct 06/2006
Practices	203	Oct 06/2006
	204	Oct 06/2006
	205	Oct 06/2006
	206	Oct 06/2006
	207	Oct 06/2006
	208 blank	Oct 06/2006
79-21-03	201	Oct 06/2006
Maintenance	202	Oct 06/2006
Practices	203	Oct 06/2006
	204	Oct 06/2006
	205	Oct 06/2006
	206	Oct 06/2006
	207	Oct 06/2006
	208	Oct 06/2006
	209	Oct 06/2006
	210	Oct 06/2006
79-21-04	201	Oct 06/2006
Maintenance	202	Oct 06/2006
Practices	203	Oct 06/2006
	204	Oct 06/2006
	205	Oct 06/2006
	206 blank	Oct 06/2006

P&WC Proprietary Information. Subject to the restrictions on the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
DISTRIBUTION (JT15D-5R) - DESCRIPTION AND OPERATION	**79-21-00**
1. Description and Operation	1
A. Oil Tank	1
B. Oil Pump	1
C. Oil Filter	1
D. Thermostatic Bypass Valve	1
E. Centrifugal Breather	1
F. Anti-Siphon Tubes	3
OIL FILTER HOUSING (JT15D-5R) - DESCRIPTION AND OPERATION	**79-21-01**
1. Description and Operation	1
OIL FILTER HOUSING (JT15D-5R) - MAINTENANCE PRACTICES	**79-21-01**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Servicing	201
6. Removal/Installation	201
A. Removal of Oil Filter Housing	201
B. Installation of Oil Filter Housing	203
C. Removal of Oil Filter Element and Cover	204
D. Installation of Oil Filter Element and Cover	204
E. Removal of Oil Pressure Regulating Valve	205
F. Installation of Oil Pressure Regulating Valve	205
G. Removal of Oil Filter Bypass Valve	207
H. Installation of Oil Filter Bypass Valve	207
I. Removal of the Thermostatic Bypass Valve	209

P&WC Proprietary Information. Subject to the restrictions on the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
OIL FILTER HOUSING (JT15D-5R) - MAINTENANCE PRACTICES (Cont'd)	**79-21-01**
J. Installation of the Thermostatic Bypass Valve	211
K. Removal of the Oil Restrictor	211
L. Installation of the Oil Restrictor	211
7. Adjustment/Test	212
A. Adjustment of Oil Pressure Regulating Valve	212
8. Cleaning	213
A. Cleanable Oil Filter Element	213
B. Oil Filter Housing	215
C. Oil Pressure Regulating Valve	215
9. Inspection/Check	215
A. Oil Filter Element	215
B. Determine Composition of Debris	216
C. Laboratory Inspection of Metallic Debris	219
D. Laboratory Inspection of Engine Oil Sample	220
10. Fits, Clearances and Torque Loadings	224
A. General	224
CHECK VALVES AND TUBES (JT15D-5R) - DESCRIPTION AND OPERATION	**79-21-02**
1. Check Valves	1
CHECK VALVES AND TUBES (JT15D-5R) - MAINTENANCE PRACTICES	**79-21-02**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201

P&WC Proprietary Information. Subject to the restrictions on the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
CHECK VALVES AND TUBES (JT15D-5R) - MAINTENANCE PRACTICES (Cont'd)	**79-21-02**
5. Removal/Installation	201
A. Removal of Check Valves	201
B. Installation of Check Valves	203
6. Fits, Clearances and Torque Loadings	204
EXTERNAL PRESSURE OIL TUBES (JT15D-5R) - MAINTENANCE PRACTICES	**79-21-03**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal of No. 1, 2, 3 and 4 Bearings Pressure Oil Tubes	201
B. Installation of No. 1, 2, 3 and 4 Bearings Pressure Oil Tubes	204
C. Removal of the Anti-Siphon Pressure Oil Tubes	205
D. Installation of the Anti-Siphon Pressure Oil Tubes	205
6. Inspection/Check	209
A. Procedure	209
7. Cleaning/Painting	210
A. Procedure	210
EXTERNAL SCAVENGE OIL TUBES (JT15D-5R) - MAINTENANCE PRACTICES	**79-21-04**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201

P&WC Proprietary Information. Subject to the restrictions on the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
EXTERNAL SCAVENGE OIL TUBES (JT15D-5R) - MAINTENANCE PRACTICES (Cont'd)	**79-21-04**
5. Removal/Installation	201
A. Removal of No. 4 Bearing Oil Scavenge and Oil Return-to-Tank Tubes	201
B. Installation of No. 4 Bearing Oil Scavenge and Oil Return-to-Tank Tubes	203
6. Inspection/Check	204
A. Procedure	204
7. Cleaning/Painting	205
A. Procedure	205

P&WC Proprietary Information. Subject to the restrictions on the title page.

DISTRIBUTION (JT15D-5R) - DESCRIPTION AND OPERATION

1. Description and Operation

A. Oil Tank

The oil tank is an integral part of the intermediate case and is sealed at the rear by a cover which provides transfer tube pickup locations and internal passageways for pressure oil to the No. 3 bearing and scavenge oil from the Nos. 3 and 3-½ bearings.

The tank is provided with an oil filler-neck, dipstick and cap assembly, which can be mounted to either side of the intermediate case front flange. The oil level in the tank is equal to the level in the filler-neck and is indicated by the dipstick. The tank vents to the intermediate case.

For oil tank data, refer to Chapter 79-00-01, OIL SYSTEM - SERVICING.

B. Oil Pump (Ref. Fig. 1)

Pressure oil is circulated from the integral oil tank through the engine lubrication system by the oil pump pressure spur gears. The oil pump scavenge spur gears operate to pump scavenge oil from the accessory gearbox and the No. 4 bearing housing to the tank via a boss at the top left engine mount pad.

The oil pump assembly is mounted on and driven by a gear in the accessory gearbox. The oil pump housing incorporates a drain plug for draining the oil tank, which must be accomplished before the pump assembly is removed.

C. Oil Filter

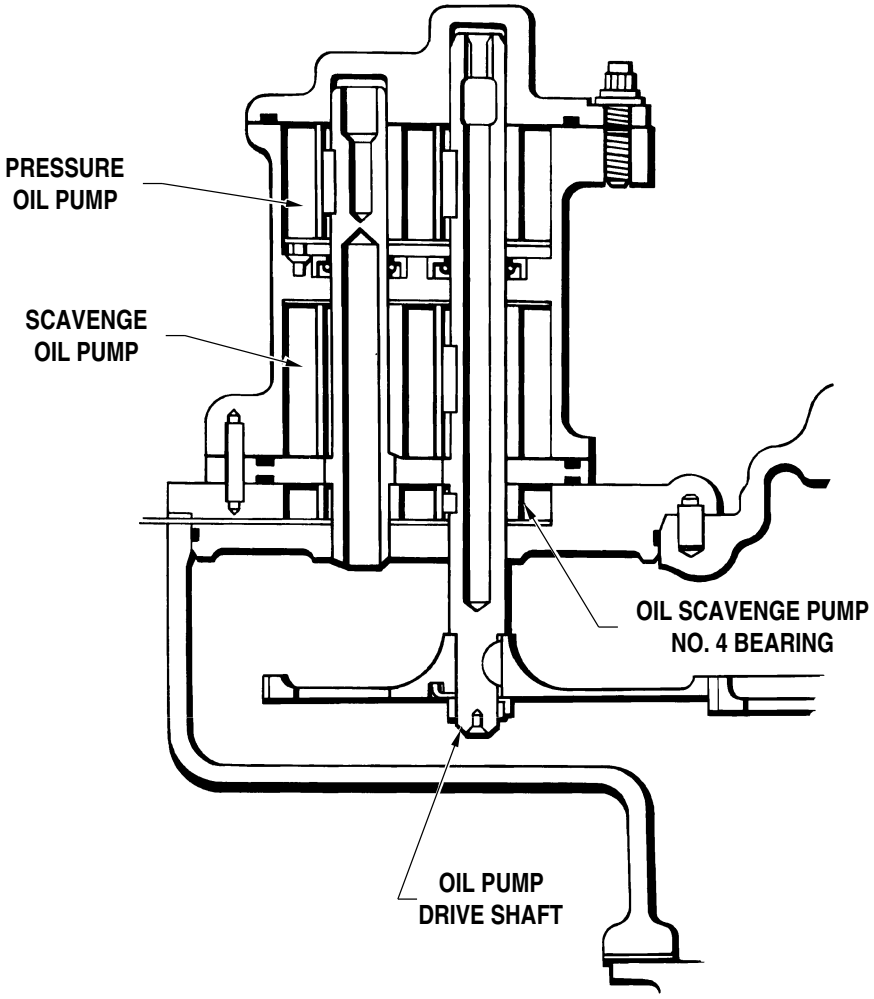
The 10-micron oil filter is housed in the oil filter housing assembly and retained within a cover. Oil passes from the outside of the filter to the center and then out through the housing at the top. In the event that the oil filter becomes blocked, the bypass valve in the housing will open, allowing unfiltered oil to pass through to the engine. A plug at the bottom of the cover allows the filter assembly to be drained before removal.

D. Thermostatic Bypass Valve

The Thermostatic Bypass Valve (TBV) controls the flow of pressure oil to the Fuel/Oil Heat Exchanger (FOHE). It is installed in the oil filter housing. Heated fuel flows from the FOHE through the TBV. When the fuel temperature is below a preset value the TBV lets oil flow through transfer tubes from the oil filter housing to the FOHE. When the fuel temperature increases above the preset value, the TBV bypasses the oil back to the pressure oil system. When the fuel temperature decreases enough, the TBV lets the oil flow to the FOHE again.

E. Centrifugal Breather

Air from the engine bearing compartments and the accessory gearbox is extracted from the air/oil mist and vented overboard through the action of an aluminum alloy, impeller-type centrifugal breather. The breather is mounted on the main shaft assembly of the gearbox. The pressure difference between the air in the gearbox and the



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Oil Pump
Figure 1

ambient atmosphere causes the air/oil mist in the gearbox to flow radially inward through the impeller. As the mist passes through the impeller, the oil particles adhere to the vanes and are thrown radially outward by centrifugal force. The relatively oil free air passes through the hollow main shaft to a breather adapter, mounted at the rear on the gearbox cover. An airframe-supplied overboard vent line must be connected to the gearbox breather adapter.

F. Anti-Siphon Tubes

An anti-siphon tube is installed on the right side of the engine on Flange B. The anti-siphon tube is part of the pressure oil system. A tube connects from the tee fitting at the top of the anti-siphon tube to a vent to the intermediate case mounted on the top of the engine.

OIL FILTER HOUSING (JT15D-5R) - DESCRIPTION AND OPERATION

1. Description and Operation

The oil filter housing assembly is mounted on the accessory gearbox, on the right side of the engine. The assembly comprises a removable alloy filter housing containing an oil filter element, two check valves, a pressure relief valve assembly, a thermostatic bypass valve and an oil filter bypass valve. Bosses at the top of the housing provide for the installation of an oil temperature bulb and an oil pressure transmitter. Bosses on the front of the housing provide for the installation of the Fuel/Oil Heat Exchanger (FOHE). The oil cooler is mounted on the side of the oil filter housing.

The two check valves in the system close under spring loading to prevent gravity oil flow when the engine is not running and also allow oil system components, such as the oil filter and external transfer tubes downstream of the check valves, to be removed for servicing without draining the oil tank.

The spring-loaded filter bypass valve is installed at the oil inlet end of the filter element housing and is normally closed. In the event of filter blockage, increased pressure overcomes the bypass valve spring force and opens the valve to permit an unrestricted, unfiltered oil flow to the bearings.

Engine oil pressure is regulated by a spring-loaded piston-type valve which operates in a ported sleeve. The valve senses oil pressure downstream of the filter and all excess oil in excess of the regulated pressure is returned directly to the tank.

The thermostatic bypass valve controls the flow of pressure oil to the FOHE. If the fuel temperature gets too high the bypass valve stops the flow of oil to the FOHE.

OIL FILTER HOUSING (JT15D-5R) - MAINTENANCE PRACTICES

1. General

   A. The following describes removal, servicing and installation of oil filter element, housing and relief valve. Refer to INTRODUCTION for Build Specification (BS) details.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC11-027	Petroleum Solvent
PWC05-128	Lapping Compound

3. Special Tools

   The special tools listed below are used in the following procedures.

Tool No.	Name
PWC30128-20	Puller
PWC31660	Puller
PWC31871	Adjusting Tool
PWC52451	Lapping Driver

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Servicing

   Refer to Chapter 72-00-00, SERVICING for oil system servicing.

6. Removal/Installation

   A. Removal of Oil Filter Housing (Ref. Fig. 201)

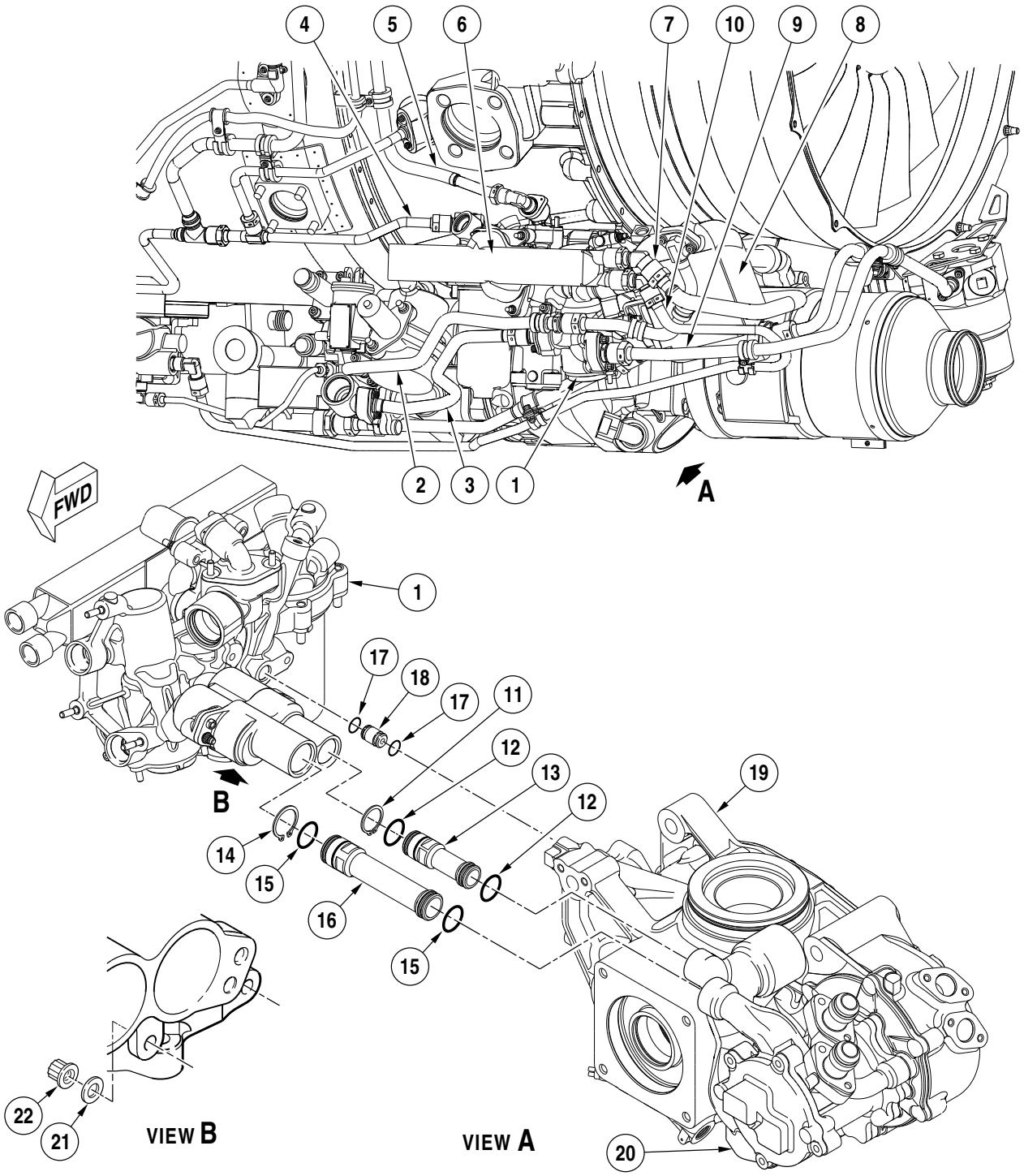
      (1) Drain oil from engine (Ref. 79-00-01, OIL SYSTEM - SERVICING).

      (2) Remove the flowmeter-to-oil cooler fuel tube (7), the oil cooler-to-FDV fuel tube (10), the rear pump-to-FOHE fuel tube (2), filter-to-TBV fuel tube (9) and the TBV-to-pump fuel tube (3) (ref. 73-10-01).

      (3) Remove the Fuel/Oil Heat Exchanger (FOHE) (8) from the oil filter housing (1) (Ref. 73-10-14).

      (4) Cut the lockwire and disconnect the oil pressure tubes (4) and (5) from the oil filter housing (1).

      (5) Remove the retaining rings (11) and (14) from the oil transfer tubes (13) and (16). Push the transfer tubes into the coupling on the oil filter housing (1).



C109300

Removal/Installation - Oil Filter Housing
Figure 201

Key to Figure 201

1. Oil Filter Housing
2. Rear Pump-to-FOHE Fuel Tube
3. TBV-to-Pump Fuel Tube
4. Oil Pressure Tube
5. Anti-Siphon Oil Pressure Tube
6. Oil Cooler
7. Flowmeter-to-Oil Cooler Fuel Tube
8. Fuel/Oil Heat Exchanger (FOHE)
9. Filter-to-TBV Fuel Tube
10. Oil Cooler-to-FDV Fuel Tube
11. Retaining Ring
12. Preformed Packing
13. Oil Transfer Tube
14. Retaining Ring
15. Preformed Packing
16. Oil Transfer Tube
17. Preformed Packing
18. Oil Transfer Tube
19. Accessory Gearbox
20. Oil Pump
21. Washer
22. Self-Locking Nut

(6) Hold the the oil filter housing (1) and remove the nuts (22) and the washers (21) that attach the oil filter housing (1) to the accessory gearbox (19). Remove the oil filter housing.

(7) Remove the oil transfer tubes (18), (13) and (16) from the oil filter housing (1). Remove and discard the packings (17), (12), and (15) from the transfer tubes.

B. Installation of Oil Filter Housing (Ref. Fig. 201)

(1) Apply a light film of oil (PWC03-001) to preformed packings (12), (15), and (17).

(2) Install the preformed packings (12), (15), and (17) on the oil transfer tubes (13), (16), and (18).

(3) Install the oil transfer tube (18) in the oil filter housing (1).

(4) Align the transfer tube (18) with the AGB (19) and attach the oil filter housing (1) to the AGB (19) with the washers (21) and the nuts (22). Torque the nuts (22) 32 to 36 lbf.in.

(5) Install the transfer tubes (13) and (16) in the coupling on the oil filter housing (1). Push the tubes fully inside the coupling.

(6) Slide the other end of the transfer tubes into the oil pump (20).

(7) Install the retaining rings (11) and (14) on the transfer tubes (13) and (16).

(8) Apply anti-seize (PWC06-009) compound to the tube connections for the oil pressure tubes (4) and (5).

(9) Connect the oil pressure tubes (4) and (5) to the oil filter housing (1). Torque the tube (4) 200 to 225 lbf.in. Torque the tube (5) 225 to 250 lbf.in.

(10) Install the FOHE (8) on the oil filter housing (1) (Ref. 73-10-14).

(11) Install the flowmeter-to-oil cooler fuel tube (7), the oil cooler-to-FDV fuel tube (10), the rear pump-to-FOHE fuel tube (2), filter-to-TBV fuel tube (9) and the TBV-to-pump fuel tube (3) (ref. 73-10-01).

(12) Lockwire the tube connections.

(13) Fill engine oil system (Ref. 72-00-00, OIL SYSTEM: SERVICING - Filling Oil System).

C. Removal of Oil Filter Element and Cover (Ref. Fig. 202)

(1) Removal of Oil Filter Element

CAUTION: WHENEVER OIL FILTER ELEMENT IS BEING REMOVED FOR A ROUTINE CHECK OR AS A TROUBLESHOOTING AID, THE OIL FILTER COVER SHOULD NOT BE DRAINED PRIOR TO REMOVAL IN ORDER TO FACILITATE INSPECTION OF CONTENTS.

(a) If engine oil is to be inspected, remove drain plug (11) and collect oil in a clean container. Remove and discard preformed packing (10).

(b) Remove four self-locking nuts (9) and washers (8) holding oil filter cover (7) to oil filter housing assembly (1).

(c) Remove oil filter cover (7) with oil filter element (5) installed.

(d) Remove retaining ring (3) and remove filter element.

D. Installation of Oil Filter Element and Cover (Ref. Fig. 202)

(1) Installation of Oil Filter Element

(a) Clean oil filter element and housing prior to installing (Ref. Para. 8.).

(b) Install new preformed packing (4) in oil filter element (5) and new preformed packing (6) on oil filter cover (7).

(c) Insert oil filter element (5) into oil filter cover (7) with the three tangs up and secure with retaining ring (3).

(d) Position spacer (2) on oil filter housing assembly (1).

(e) Install oil filter cover (7) with oil filter element (5). Secure with four washers (8) and self-locking nuts (9). Torque nuts 65 to 85 lb.in.

CAUTION: DO NOT TIGHTEN DRAIN PLUG MORE THAN MAXIMUM TORQUE VALUE.

(f) If removed, install new preformed packing (10) on oil filter cover drain plug (11). Install drain plug and tighten as follows:

1 Torque oil filter cover drain plug 40 to 50 lb.in. then lockwire.

(g) Service engine oil system (Ref. 72-00-00, SERVICING).

E. Removal of Oil Pressure Regulating Valve (Ref. Fig. 203)

(1) Drain residual oil from oil filter housing (6). Discard preformed packing. Remove three bolts (12) and washers (13).

(2) Remove drain adapter (14) with preformed packing (10). Discard preformed packing.

(3) Loosen and remove valve spring seat (9) using adjusting tool (PWC31871).

NOTE: For reference at assembly, record number of turns valve seat was threaded into housing.

(4) Remove pressure regulating valve spring seat (9) with compression spring (8) and remove pressure relief valve (7).

(5) If required to remove sleeve (5):

(a) Remove retaining ring (11).

(b) Install puller (PWC31660) and remove sleeve.

(c) Remove and discard two preformed packings (15) from sleeve (5).

F. Installation of Oil Pressure Regulating Valve (Ref. Fig. 203)

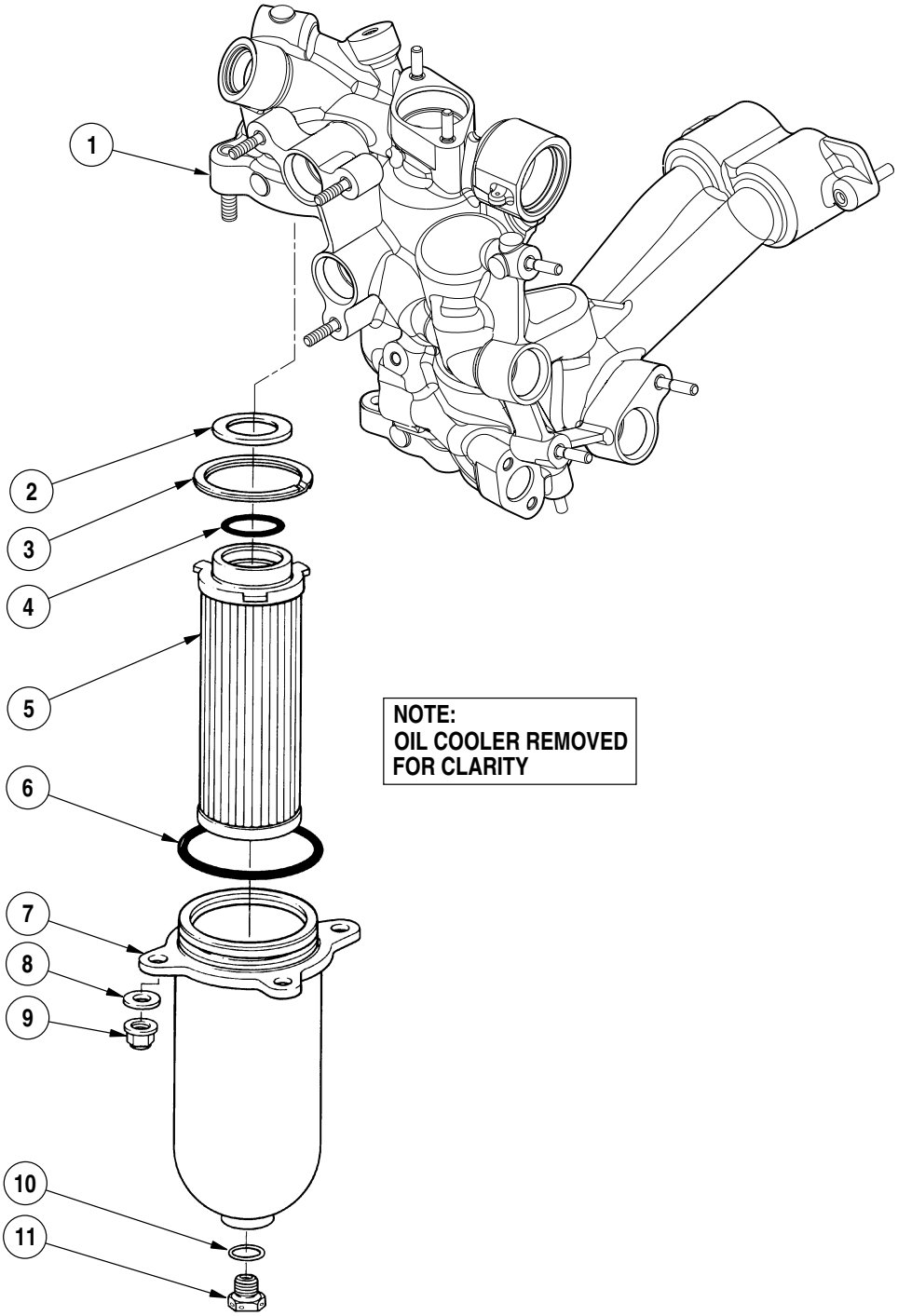
(1) If sleeve (5) was removed, reinstall as follows:

(a) Install two new preformed packings (15) onto sleeve (5).

(b) Carefully insert sleeve (5) and push into oil filter housing (6) using puller (PWC31660); ensure sleeve is fully seated in oil filter housing.

(c) Install retaining ring (11) and remove puller (PWC31660).

(2) Insert one end of compression spring (8) over stem of regulating valve (7) and other end into pressure regulating valve spring seat (9). Insert parts into regulating valve housing and screw seat (9) inward with adjusting tool (PWC31871), the same number of turns as recorded during removal.



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Removal/Installation - Oil Filter Element and Cover
Figure 202

Key to Figure 202

1. Oil Filter Housing Assembly
2. Spacer
3. Retaining Ring
4. Preformed Packing
5. Oil Filter Element
6. Preformed Packing
7. Oil Filter Cover
8. Washer
9. Self-locking Nut
10. Preformed Packing
11. Drain Plug

(3) Install new preformed packing (10) on drain adapter (14).

(4) Install drain adapter (14) as follows:

(a) Secure drain adapter with three washers (13) and three bolts (12). Tighten and torque bolts 32 to 36 lb.in. Lockwire bolts.

NOTE: Ensure that lugs on pressure regulating valve spring seat (9) are aligned with locking slot in drain adapter (14). If necessary, minimally rotate spring seat to obtain alignment.

G. Removal of Oil Filter Bypass Valve (Ref. Fig. 203)

(1) Remove shipping cap (17) and washer (18).

NOTE: If there is a pressure sensor installed refer to the Aircraft Maintenance Manual (AMM) for instructions.

(2) Remove bypass valve (20) and helical compression spring (19) from oil filter housing (6).

(3) Remove shipping cap (16).

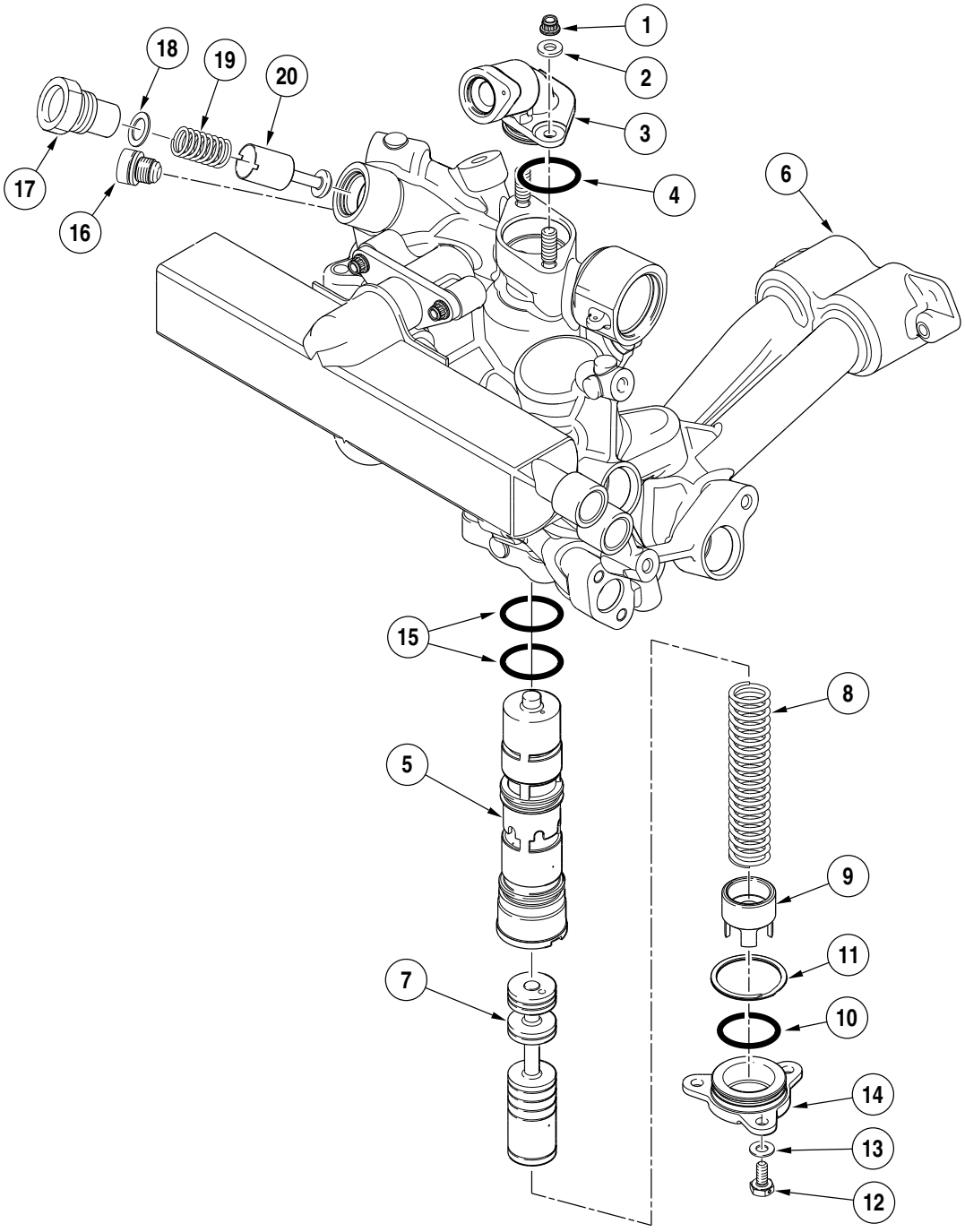
NOTE: If there is a temperature sensor installed refer to the AMM for instructions.

H. Installation of Oil Filter Bypass Valve (Ref. Fig. 203)

(1) On a clean workbench apply a small quantity of lapping compound (PWC05-128) to the chamfer of the bypass valve (20).

(2) Put the valve into the oil filter housing. Use lapping driver (PWC52451) to apply a light pressure and rotate the valve against the mating surface in the oil filter housing.

(3) Remove the lapping driver and the bypass valve from the oil filter housing.



C109141

Removal/Installation - Oil Pressure Regulating Valve and Filter Bypass Valve Assembly
Figure 203

Key to Figure 203

1. Nut
2. Washer
3. Elbow
4. Preformed Packing
5. Sleeve
6. Oil Filter Housing
7. Pressure Relief Valve
8. Helical Compression Spring
9. Pressure Regulating Valve Spring Seat
10. Preformed Packing
11. Retaining Ring
12. Bolt
13. Washer
14. Drain Adapter
15. Preformed Packing
16. Shipping Cap
17. Shipping Cap
18. Washer
19. Helical Compression Spring
20. Oil Filter Bypass Valve

(4) Use petroleum solvent (PWC11-027) to clean the bypass valve and the bypass valve port in the oil filter housing (Ref. 70-00-00, STANDARD PRACTICES - CLEANING).

(5) Drain all cleaning fluid from the parts. Use clean compressed air to remove all residual fluid, if necessary.

(6) Insert bypass valve (20) in oil filter housing (6) and locate compression spring (19) in bypass valve.

(7) Install the shipping cap (17).

NOTE: To install the oil pressure sensor refer to the AMM for instructions.

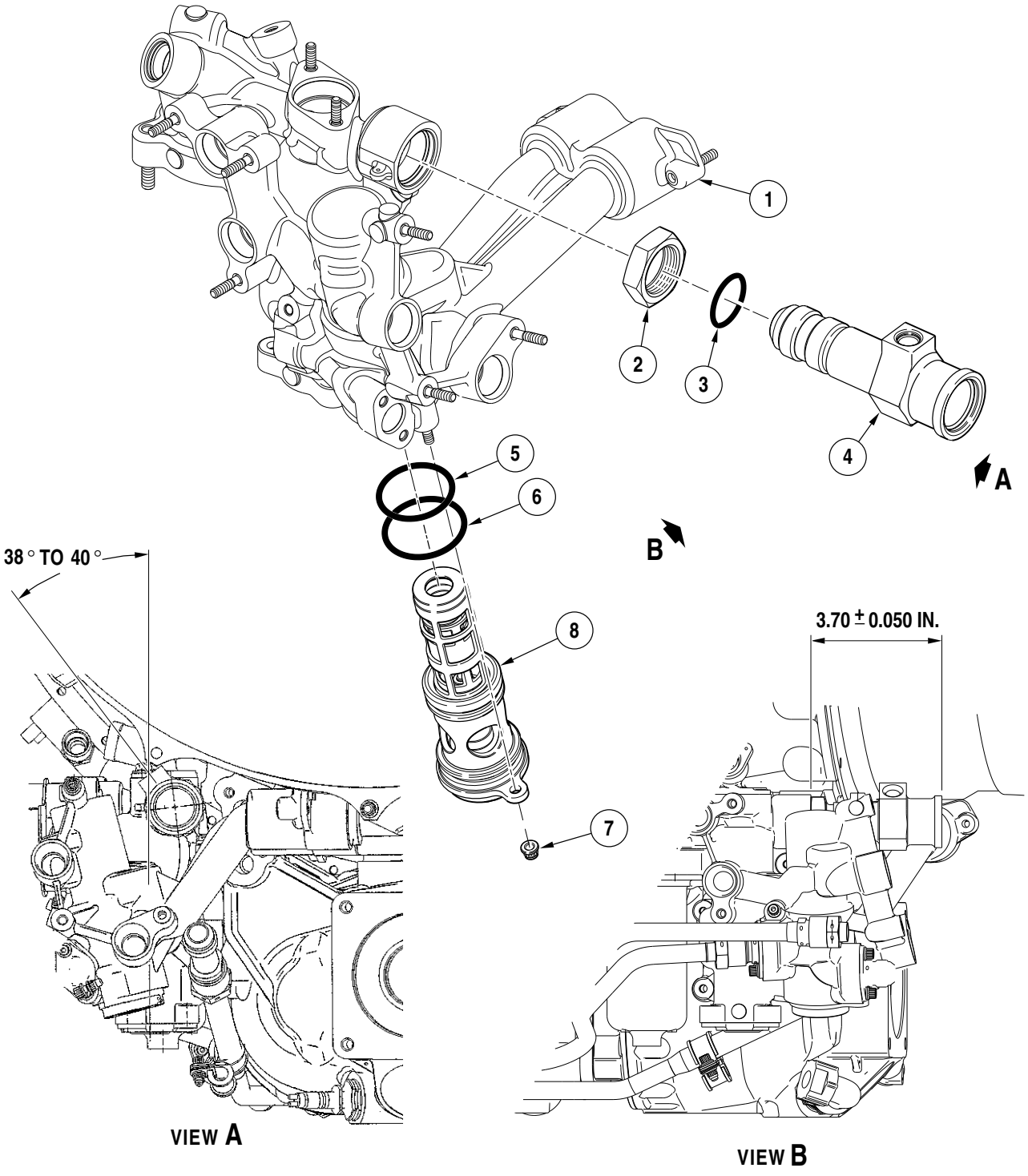
(8) Install the shipping cap (16).

NOTE: To install the oil temperature sensor refer to the AMM for instructions.

I. Removal of the Thermostatic Bypass Valve (Ref. Fig. 204)

(1) Remove the two nuts (7).

(2) Install the puller (PWC30128-20) in the threaded opening on the thermostatic bypass valve (9).



C109140

Removal/Installation - Thermostatic Bypass Valve and Restrictor
Figure 204

Key to Figure 204

1. Oil Filter Housing
2. Nut
3. Preformed Packing
4. Restrictor
5. Preformed Packing
6. Preformed Packing
7. Nut
8. Thermostatic Bypass Valve

(3) Pull the thermostatic bypass valve (8) from the oil filter housing (1).

(4) Remove the preformed packings (5) and (6) from the thermostatic bypass valve (8). Discard the packings.

J. Installation of the Thermostatic Bypass Valve (Ref. Fig. 204)

(1) Apply a light film of oil (PWC03-001) to preformed packings (5) and (6).

(2) Install the preformed packings (5) and (6) on the thermostatic bypass valve (8).

CAUTION: MAKE SURE YOU DO NOT DAMAGE THE PREFORMED PACKINGS WHEN YOU INSTALL THE THERMOSTATIC BYPASS VALVE IN THE OIL FILTER HOUSING. DAMAGED PACKINGS CAN CAUSE CONTAMINATION OF THE FUEL AND OIL SYSTEMS.

(3) Carefully push the thermostatic bypass valve (8) into the oil filter housing (1).

(4) Attach the thermostatic bypass valve (8) to the oil filter housing (1) with the nuts (7). Torque the nuts (7) 32 to 36 lbf.in.

K. Removal of the Oil Restrictor (Ref. Fig. 204)

(1) Remove the engine oil pressure transmitter from the engine (Ref. Aircraft Maintenance Manual).

(2) Use an approved marker and put an index mark on the oil filter housing (1) and the restrictor (4).

(3) Remove the oil filter housing (1) from the engine (Ref. para. 6.A.).

(4) Loosen the nut (2) and remove the restrictor (4) from the oil filter housing (1).

(5) Remove the preformed packing (3) from the restrictor (4). Discard the packing.

L. Installation of the Oil Restrictor (Ref. Fig. 204)

(1) Apply a light film of oil (PWC03-001) to preformed packing (3).

(2) Install the preformed packing (3) on the restrictor (4).

(3) Put the nut (2) on the restrictor (4).

(4) Install the restrictor (4) in the oil filter housing (1).

(5) Align the index mark on the restrictor (4) with the mark on the oil filter housing (1).

(6) If the there is no index mark, install the restrictor (4) on the oil filter housing (1) to meet the dimensions from View A and View B (Ref. Fig. 204).

(7) Torque the nut (2) 285 to 315 lbf. in.

(8) Install the oil filter housing (1) on the engine (Ref. para. 6.B.).

(9) Install the engine oil pressure transmitter (Ref. Aircraft Maintenance Manual).

(10) Make sure there is at least 0.5 in. clearance between the oil pressure transmitter and the engine.

7. Adjustment/Test

A. Adjustment of Oil Pressure Regulating Valve (Ref. Fig. 203)

NOTE: Engines must be shut down during adjustment of oil pressure regulating valve, except as noted.

(1) Remove three bolts (12) and washers (13).

(2) Remove drain adapter (14) with preformed packing (10). Discard preformed packing.

(3) Install adjusting tool (PWC31871) in oil filter housing assembly.

(4) Adjust pressure regulating valve spring seat (9) clockwise to increase oil pressure, or counterclockwise to decrease oil pressure.

NOTE: 1. An adjustment of one turn will change oil pressure 3 to 5 psi.

NOTE: 2. If adjusting tool (PWC31871) only is used, adjustment may be performed while the engine is running.

(5) Remove adjusting tool (PWC31871).

NOTE: Ensure that lugs on pressure regulating valve spring seat (9) are aligned with locking slot in drain adapter (14). If required, rotate spring seat minimally to obtain alignment.

(6) Install new preformed packing (10) on drain adapter (14). Mount drain adapter on housing (6) and secure with three washers (13) and bolts (12). Tighten and torque bolts to 32 to 36 lb.in.

8. Cleaning

A. Cleanable Oil Filter Element

NOTE: The following oil filter element cleaning procedure applies only to cleanable oil filters. Do not use this procedure for the disposable oil filters which are of a non-cleanable design.

(1) Seal central tube opening of element using a suitable size rubber or plastic plug.

(2) Place filter element in tank of electrosonic cleaner.

(3) Sonac S-2 Electrosonic Cleaner (Ref. Fig. 205)

(a) Pour sufficient quantity of petroleum solvent (PWC11-027) into cleaning tank. Keep fluid level approximately 1/4 inch below tank edge to avoid spillage.

(b) Operate cleaner for ten minutes.

(c) Rotate filter element 180 degrees and operate cleaner for a further ten minutes.

NOTE: It may be required to vary duration of cleaning interval, depending upon filter element condition. However, for optimum results, solvent should be replaced after 20 minutes of cleaning.

(4) Kellstrom KS5518 Electrosonic Cleaner:

(a) Pour enough petroleum solvent (PWC11-027) into cleaning tank to completely immerse oil filter element.

(b) Operate cleaner for 20 minutes.

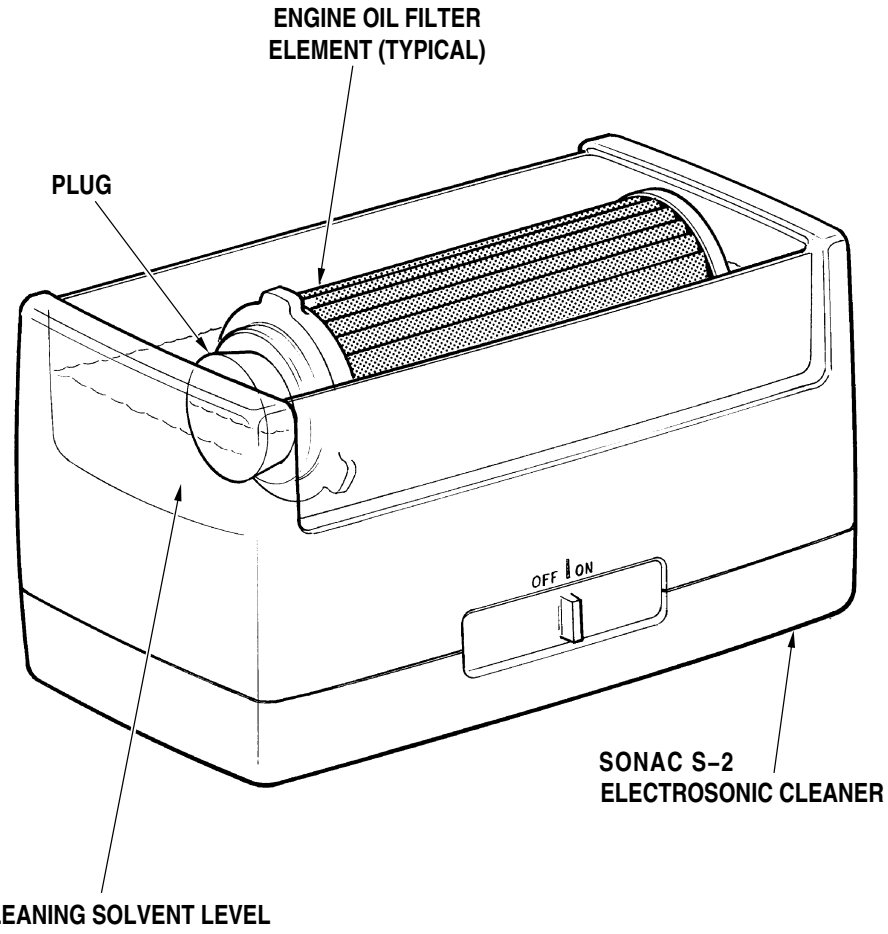
NOTE: Cleaning duration may require adjusting, depending upon filter element condition. However, for optimum results, solvent should be replaced after 20 minutes of cleaning.

(5) After cleaning oil filter element with Sonac S-2 or Kellstrom KS5518 electrosonic cleaner, proceed as follows:

(a) Wearing clean lint-free gloves, remove element from tank and remove plug from central tube opening. Blow dry filter element using clean, dry, filtered compressed air, or allow filter element to stand and air dry.

(b) Inspect filter element visually (Ref. Para. A.) and repeat cleaning process, if necessary. Reinspect: if results are not satisfactory, send element to an approved overhaul facility for more detailed inspection and cleaning.

(c) Check and clean inside of oil filter housing before reinstalling oil filter element.



NOTE : KEEP FLUID LEVEL
1/4 INCH BELOW TANK
EDGE TO AVOID SPILLAGE.

CLEANABLE OIL FILTER ELEMENT ONLY C6816C

Electrosonic Field Cleaning of Cleanable Engine Oil Filter
Figure 205

B. Oil Filter Housing

(1) Check and clean inside of oil filter element housing before reinstalling element. Wash in petroleum solvent (PWC11-027) and use soft nylon bristle brush, if necessary. Dry housing using clean, dry, filtered compressed air blast, or allow to stand and air dry.

C. Oil Pressure Regulating Valve

CAUTION: DO NOT EXTEND, CONTRACT, BEND OR OTHERWISE DAMAGE PRESSURE REGULATING VALVE SPRING.

(1) Wash parts in clean petroleum solvent (PWC11-027). If necessary, use a nylon bristle brush to remove contaminants.

(2) Dry parts using clean, dry, filtered compressed air blast, or allow parts to stand and air dry.

9. Inspection/Check

NOTE: For periodic inspection requirements refer to Periodic Inspection table in Chapter 72-00-00.

A. Oil Filter Element

NOTE: Disposable oil filter elements are not cleanable and are designed to be removed and disposed of at periodic intervals.

(1) Inspect oil filter element for contamination:

(a) Engines with cleanable oil filters:

1 If contamination is not evident, clean the oil filter element (Ref. Para. 8.A.) and inspect, using a strong magnifying glass.

2 If contamination is evident, record amount and physical appearance of debris in engine logbook, collect debris in a clean container, then determine composition of debris in accordance with Subparagraph B..

(b) Engines with disposable oil filters: if contamination is evident, record amount and physical appearance of debris in engine logbook, collect debris in a clean container, then determine composition of debris in accordance with Subparagraph B..

(c) If more than 5% of the visible passages are blocked, establish source of contamination in accordance with Subparagraph B., then clean the cleanable oil filter element (Ref. Para. 8.A.) or reject and replace the disposable oil filter element.

(d) If dents or broken wires are found in filter element screen, establish source of contamination in accordance with Subparagraph B.. Inspect oil filter element for damage (Ref. step (2)).

(2) Inspect oil filter element for damage:

(a) If broken wires are found on oil filter element screen, replace oil filter element.

(b) Dents on oil filter element screen are acceptable to a maximum depth of 0.100 inch. Dent(s) must not occupy more than 5% of screen surface area. Replace oil filter element with damage greater than these limits.

(3) For engines with either cleanable or disposable oil filter elements that have abnormal oil filter contamination, send the Fuel/Oil Heat Exchanger (FOHE) to an approved overhaul facilty for cleaning.

B. Determine Composition of Debris

NOTE: Minor metal contamination may occur and appear at first inspection of new engines, or engines recently having completed extensive shop work. In such cases, normal precautions apply.

(1) Classify Debris

(a) Definitions:

Particle: A piece of metal less than 0.010 inch in size.

Chip: A particle larger than 0.010 inch.

Flake: An extremely thin metal chip.

Sliver: Thread-like piece of metal.

Fuzz or Powder: A mass of very fine and light particles.

(b) The following are examples of possible debris contamination:

Non-ferrous metal flakes: these typically originate from bearings or bushings made of aluminum or brass.

Ferrous metal flakes: these typically originate from spalled anti-friction bearings, gear teeth or fretting wear.

Non-metallic flakes: these typically originate from spalled coating inside the oil filter housing or oil tank.

Steel slivers: these typically originate from interference between steel parts or from heavy scoring.

Powdered material or metallic fuzz: this material is normally plasma coating, and may originate from light air seal rub.

Carbon particles or flakes: this material usually originates from the No. 4 bearing housing.

(2) Carbon Particles

(a) Remove oil pump to access oil strainers located in accessory gearbox (Ref. 72-60-02) and intermediate case (Ref. 72-60-01).

(b) Inspect pressure oil inlet strainer (intermediate case) and scavenge oil strainer (accessory gearbox) for presence of carbon particles or other debris following same procedures as oil filter element (Ref. Subpara. A.). Clean oil strainer element and oil strainer sleeve (Ref. 72-60-01).

(c) Remove emergency fuel shutoff control linkage from No. 4 bearing housing assembly and disassemble No. 4 bearing housing assembly (Ref. 72-50-06).

(d) Clean, inspect and reassemble No. 4 bearing housing components (Ref. 72-50-06). Reinstall emergency fuel shutoff control linkage on bearing housing assembly (Ref. 72-50-06).

(e) Engines with cleanable filters: clean the engine oil filter element (Ref. Para. 8.A.).

(f) Engines with disposable filters: remove the oil filter element and install a new filter element.

(g) Reinstall all removed components in accordance with chapters referenced above.

(h) Drain, flush and replenish engine oil tank (Ref. 72-00-00, SERVICING).

(3) If three or more metallic flakes or dark, irregularly-sized chips are found in oil filter element, laboratory analysis of the debris and engine oil is required. Proceed as follows:

(a) Perform a spectrographic analysis on debris to determine alloy type (Ref. Subpara. C., following).

NOTE: Material collected at the oil filter and from the pressure oil inlet strainer (inlet case) and scavenge oil strainer (accessory gearbox) should be analyzed separately to aid in isolating source of contamination.

(b) Drain engine oil sample (Ref. 72-00-00, SERVICING) into a clean container and perform spectrometric oil analysis (SOAP) test (Ref. Subpara. C., following).

(4) Engines with cleanable filters: clean the oil filter element (Ref. Para. 8.A.) and reinstall for continued operation.

(5) Engines with disposable filters: no debris analysis is required. Remove the oil filter element and install a new filter element. Continue engine operation.

(6) White Metal:

(a) Engines with cleanable filters: clean and reinstall oil filter element (Ref. Para. 8.A.). Inspect oil filter after 10 hours of engine operation.

(b) Engines with disposable filters: on first discovery, remove and replace engine oil filter element. Inspect oil filter after 10 hours of engine operation.

(c) On second discovery of similar amount of metal,

1 Engines with cleanable filters: on second discovery of similar amount of metal, clean and reinstall cleanable oil filter element, then drain and replenish engine oil system with new engine oil (Ref. 72-00-00, SERVICING). Inspect oil filter after 10 hours operation.

2 Engines with disposable filters: on second discovery of similar amount of metal, remove and replace oil filter element, then drain and replenish engine oil system with new engine oil (Ref. 72-00-00, SERVICING). Inspect oil filter after 10 hours of engine operation.

(d) On third discovery of similar white metal, remove and inspect the pressure and scavenge oil check valves for fretting or abnormal wear as a possible source of debris (Ref. 79-21-02, MAINTENANCE PRACTICES).

1 If no fretting wear or abnormal wear is noted during pressure and scavenge oil check valve inspection, remove engine from service and send the engine to a P&WC approved overhaul facility for inspection.

2 If the oil check valves were determined to be unserviceable and have been replaced, install new oil filter element. Drain and replenish engine oil system (72-00-00, SERVICING). Inspect the oil filter element after 10 hours of operation.

3 If the same amount of white metal is discovered during the check following 10 hours of operation, send the engine to a P&WC approved overhaul facility for further inspection and investigation.

(7) Bronze or Steel:

(a) On first discovery:

1 Engines with cleanable filters: clean oil filter element (Ref. Para. 8.A.), drain residual oil from accessory gearbox into a clean container (Ref. Ref. 72-00-00, SERVICING) and visually inspect for unsuspended particles. If drained oil is free of unsuspended particles, proceed to step (c).

2 Engines with disposable filters: On first discovery, remove and replace oil filter element, then drain residual oil from accessory gearbox into a clean container and visually inspect for unsuspended particles (Ref. 72-00-00, SERVICING). If drained oil is free of unsuspended particles, proceed to step (c).

3 Remove and replace oil filter element, then drain residual oil from accessory gearbox into a clean container and visually inspect for unsuspended particles (Ref. 72-00-00, SERVICING). If drained oil is free of unsuspended particles, proceed to step (c).

(b) If unsuspended particles are evident, remove oil pump (Ref. 72-60-02) and inspect oil pump scavenge screen in AGB. If particles are evident on scavenge screen, the engine should be shipped to an overhaul facility for inspection. If unsuspended particles are not evident on oil pump scavenge screen, proceed to next step.

(c) Drain and replenish with new engine oil (Ref. 72-00-00, SERVICING), perform ground run (Ref. 71-00-00, ADJUSTMENT/TEST) for one hour and recheck filter.

NOTE: A one hour ground run consists of 3 cycles of 20 minutes. Each cycle consists of 10 minutes at idle speed and 10 minutes at 80% of maximum N1 speed.

(d) If a greater quantity of steel or bronze is found after one hour ground run, the engine should be shipped to an approved overhaul facility for inspection. If a smaller quantity of metal is present:

1 Engines with cleanable filters: clean oil filter element (Ref. Para. 8.A.), then inspect it after 5 to 10 hours of engine operation.

2 Engines with disposable filters: replace existing filter with a new filter, then inspect it after 5 to 10 hours of engine operation.

(e) If recheck after 5 to 10 hours operation reveals presence of a similar quantity of steel or bronze, the engine should be returned to an approved overhaul facility for inspection.

C. Laboratory Inspection of Metallic Debris

(1) Laboratory Spectrographic Analysis of Metallic Debris

(a) Analyze debris collected from main oil filter element and the pressure oil inlet strainer (inlet case) and the oil scavenge strainer (accessory gearbox) by spectrograph for presence of the following materials:

Material	Possible Source
AMS6444 (52100)	Bearing ball and/or race material.
AMS6491 (M-50)	Bearing ball, bearing roller and/or race material.
AMS6414 (4340)	Bearing cage.
AMS6415 (4340)	Bearing cage.
AMS5646 (30347)	No. 2 bearing keywasher.
AMS5510 (30321)	AGB driveshaft upper or lower bearing keywasher.
AMS6260 (9310)	Gear
AMS6265 (9310)	Gear

(b) Proceed as follows after spectrographic analysis:

NOTE: Minor metal contamination may occur and appear at first inspection of new engines, or engines recently having completed extensive shop work. In such cases, normal precautions apply.

1 If bearing or keywasher material is found, contact your P&WC field service representative or the 24 hour CFirst Customer Help Desk for further instructions.

2 If gear material is found, ensure procedures at Paragraph 9.B., step (7) are completed.

(2) DELETED

D. Laboratory Inspection of Engine Oil Sample

(1) General - Spectrometric oil analysis is used to analyze engine oil samples for the presence of designated elements, measured in parts per million (ppm). Engine component wear may be indicated by the presence in oil samples of high concentrations of some combinations of these designated metals. By permitting the observation of engine oil metallic concentrations and trends, SOAP analysis helps detect engine component distress.

(2) Factors affecting Test Results

(a) Laboratories or technicians: oil sample SOAP results may vary if different laboratories or technicians perform tests.

(b) Ambient conditions: test results may reflect the ambient conditions in which the engine was operated. For example, an oil sample taken from an engine having operated in a maritime environment may contain a high salt content, therefore a higher sodium (Na) content.

(c) Sampling intervals and sample drainage locations: random oil sampling intervals or changing engine oil sample drainage location affects test results and makes trend monitoring very difficult.

(3) SOAP Method

(a) SOAP tests shall be analyzed using the atomic emission method.

(b) The atomic emission method is used by Raytheon Aircraft Co. and by Pratt & Whitney Canada Inc. chemical laboratories. The atomic emission method is known to produce very accurate results and may be completed using the Inductively Coupled Plasma (ICP) method or the ignition method.

(c) It is recommended that engine oil SOAP samples are taken: after the engine has run for at least 30 minutes; within ten minutes of engine shutdown; prior to the addition of any new engine oil.

(d) It is recommended that engine oil SOAP samples be consistently taken from the same location on the engine. It is recommended that oil samples be drained consistently from either the AGB or the oil pump drain locations (Ref. 72-00-00, SERVICING).

(e) It is recommended that engine oil SOAP samples be consistently taken at regular intervals and tested at the same laboratory.

(f) It is recommended that engine oil acidity levels be measured at regular intervals. Refer to step (4) for allowable engine oil acidity levels.

(g) Refer to Table 201 for allowable SOAP ranges and recommendations. These limits are based on initial data and will be reviewed as more information becomes available.

TABLE 201, Engine Oil Soap Limits in Parts per Million (ppm)

Element	Normal Range (See NOTE 1.)	Marginal Range (See NOTE 1.)	High Range (See NOTE 2.)	Abnormal Range (See NOTE 2.)	Abnormal Trend (ppm increase in 25 hours) (See NOTE 3.)
Ag (Silver)	0 to 3	between 4 and 5	6	7	3
Al (Aluminium)	0 to 6	between 7 and 10	11	12	4
B (Boron)	0 to 4	between 5 and 6	7	8	2
Cu (Copper)	0 to 3	between 4 and 5	6 to 8	9	3
Cr (Chromium)	0 to 3	between 4 and 6	7 to 8	9	3
Fe (Iron)	0 to 5	between 6 and 8	9 to 11	12	3
Mg (Magnesium)	0 to 7	between 8 and 10	11 to 14	15	6
Mo (Molybdenum)	0 to 5	between 6 and 7	8 to 11	12	3
Na (Sodium)	0 to 8	between 9 and 10	11	12	2
Ni (Nickel)	0 to 6	between 7 and 9	10 to 15	16	6
Pb (Lead)	0 to 3	between 4 and 5	6	7	2
Si (Silicon)	0 to 27	28 to 30	31 to 34	35	10

TABLE 201, Engine Oil Soap Limits in Parts per Million (ppm) (Cont'd)

Element	Normal Range (See NOTE 1.)	Marginal Range (See NOTE 1.)	High Range (See NOTE 2.)	Abnormal Range (See NOTE 2.)	Abnormal Trend (ppm increase in 25 hours) (See NOTE 3.)
Sn (Tin)	0 to 19	20 to 22	23 to 24	25	4
Ti (Titanium)	0 to 5	6	7	8	2
Zn (Zinc)	0 to 4	between 5 and 6	6	7	2
NOTE: 1. See step D.(5) for recommended maintenance action.					
NOTE: 2. See step D.(6) for recommended maintenance action.					
NOTE: 3. See step D.(8) for recommended maintenance action.					
NOTE: 4. Data for Be (Berylium), CD (Cadmium), Co (Cobalt), Mn (Manganese) and V (Vanadium) are currently too limited for inclusion on table.					

(4) Engine Oil Acidity

(a) The range for allowable engine oil acidity is a result indicating a total acid number between 0 and 2.0.

NOTE: The total acid number is the number of milligrams of potassium hydroxide per gram of engine oil required to neutralize the oil sample acidity.

(5) Maintenance Action - NORMAL or MARGINAL range (Ref. Table 201): continue engine in service and maintain normal SOAP sampling schedule.

(6) Maintenance Action - HIGH or ABNORMAL range (Ref. Table 201):

NOTE: In order to ensure consistency of oil samples taken while trending results are in the High to Abnormal range, cancel all scheduled engine oil changes for a period of up to 100 flight hours.

(a) Check oil filter element for blockage (Ref. Subpara.9.A.). Collect and analyze visible metal and any other visible debris. If engine is serviceable, continue in service.

(b) Perform the following after the shortest of the following intervals: between one and three hours of operation maximum since the initial sample, or after next flight:

1 Drain and analyze a second engine oil sample (Ref. 72-00-00, SERVICING).

2 Inspect engine oil filter element and determine serviceability of engine (Ref. Subpara. 9.A.). If serviceable, continue operating engine.

3 If analysis of the second oil sample indicates the presence of elements in MARGINAL or NORMAL ranges, continue engine in service and maintain normal SOAP sampling schedule.

4 If analysis of the second oil sample indicates the presence of elements in HIGH or ABNORMAL ranges, continue engine in service and refer to revised SOAP sample interval and maintenance action in step (7).

(7) Revised SOAP sample interval and maintenance action for second SOAP sample test results indicating an abnormal trend or the presence of elements in HIGH or ABNORMAL range:

NOTE: In order to ensure consistency of oil samples taken while trending results are in the High to Abnormal range, cancel all scheduled engine oil changes for a period of up to 100 flight hours.

(a) Drain and analyze a third engine oil sample after the shortest of the following intervals: between one and three hours of operation maximum since the initial sample, or after next flight (Ref. 72-00-00, SERVICING).

(b) Inspect engine oil filter element and determine serviceability of engine (Ref. Subpara. 9.A.). If serviceable, continue operating engine.

(c) If analysis of the third oil sample indicates the presence of elements in MARGINAL or NORMAL ranges, continue engine in service and return to normal SOAP sampling schedule.

(d) If analysis of the third oil sample indicates the presence of elements in HIGH or ABNORMAL ranges, refer to Table 202 and inspect engine components indicated by high or abnormal element count.

(8) Maintenance Action - ABNORMAL TREND (Ref. Table 201):

NOTE: In order to ensure consistency of oil samples taken while trending results indicate an abnormal trend, cancel all scheduled engine oil changes for a period of up to 100 flight hours.

(a) Regardless of the current oil sampling interval, if a sudden trend increase of any element occurs that is equal to or greater than the value specified on Table 201 'Abnormal Trend' column, then perform a second sample prior to next flight to confirm the abnormal trend.

(b) If the second sample taken prior to the next flight indicates a return to typical normal readings, then return engine to service and resume normal engine oil SOAP sampling schedule.

(c) If the second sample taken prior to the next flight indicates a result which continues to fall within Table 201 'Abnormal Trend' column, return engine to service and perform maintenance actions in step (7).

TABLE 202, Selected Engine Components and Composition

Element Composition	Engine Component(s): Bearings and Gears
Main elements: Chromium, Copper, Iron, Manganese, Nickel and Silicon.	No. 1 brg., No. 2 brg., AGB driveshaft upper and lower bearings, and associated races
Main elements: Cobalt, Chromium, Iron, Manganese, Molybdenum, Nickel, Silicon and Vanadium .	No. 3 brg. , No. 3 ½ brg. and No. 4 brg. rollers
Main elements: Chromium, Copper, Iron, Manganese, Molybdenum, Nickel, Silicon; trace amounts of Silver.	No. 3 brg. , No. 3 ½ brg. and No. 4 brg. bearing cages
Main elements are Chromium, Copper, Iron, Manganese, Molybdenum, Nickel and Silicon.	Accessory gearbox and oil pump gears
Main elements: Chromium, Manganese, Nickel, Silicon; trace amounts of Aluminum and Tin.	No. 4 Bearing air seal (on LPT rotor)

10. Fits, Clearances and Torque Loadings

A. General

Refer to Tables 203,204, 205, 206, and to Figure 206.

TABLE 203, Fits and Clearances

REF. NO.	Name	Dim. for Ref. (inches) Min.	Dim. for Ref. (inches) Max.	Limits (inches) Min.	Limits (inches) Max.	Limits (inches) Replace
1146	Valve, Pressure Regulating	0.8502	0.8507	0.0003	0.0016	
	Sleeve, Pressure Regulating Valve	0.8510	0.8518			
1147	Valve, Pressure Regulating	0.8502	0.8507	0.0003	0.0016	
	Sleeve, Pressure Regulating Valve	0.8510	0.8618			
1150	Sleeve, Oil Filler Housing	0.9896	0.9900	0.0005T	0.0020T	
	Housing, Oil Filler	0.9880	0.9891			

TABLE 203, Fits and Clearances (Cont'd)

REF. NO.	Name	Dim. for Ref. (inches) Min.	Dim. for Ref. (inches) Max.	Limits (inches) Min.	Limits (inches) Max.	Limits (inches) Replace
1151	Valve, Oil Filter Bypass	0.6400	0.6410	0.0010	0.0030	
	Housing, Oil Filter	0.6420	0.6430			

TABLE 204, Torque and Stretch

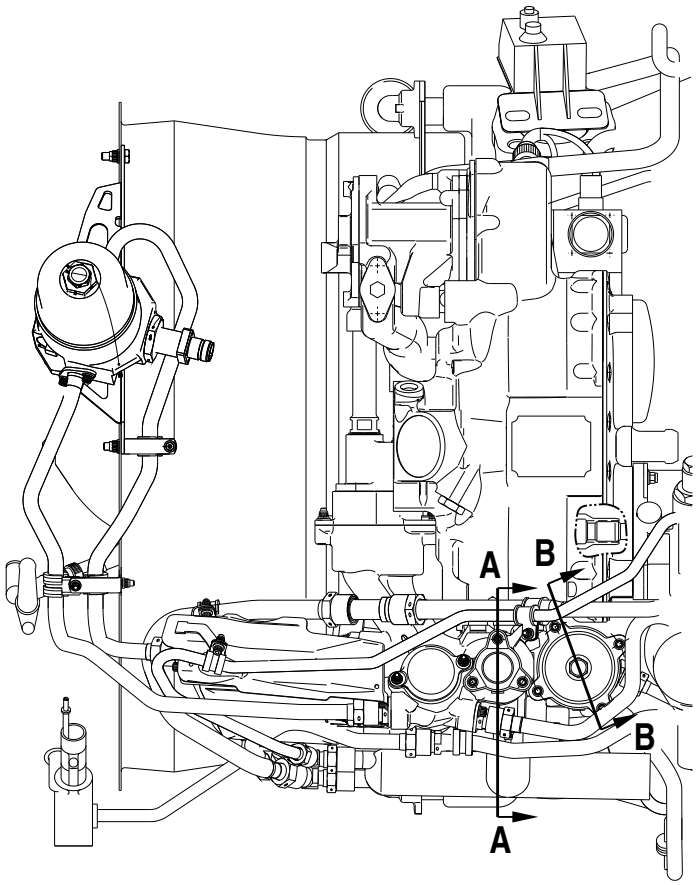
REF. NO.	Name	Limits Min.	Limits Max.
1715	Oil Filter Housing Plate Retaining Screw	10 lb.in.	15 lb.in.

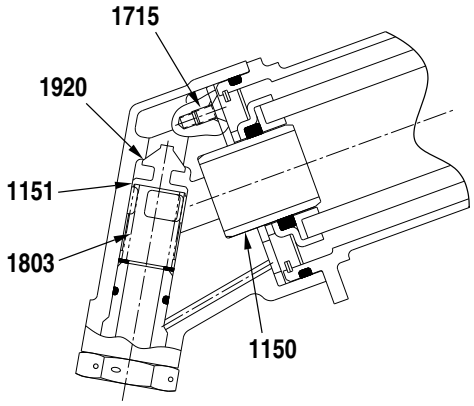
TABLE 205, Spring Pressure

REF. NO.	Name	Limits Min.	Limits Max.
1802	Spring, Pressure Regulating Valve		
	At length 2.453	29 lb. 13 oz.	31 lb. 5 oz.
	At length 3.800	9 lb. 12 oz.	11 lb. 4 oz.
1803	Spring, Oil Filter Bypass Valve		
	At length 0.900	3 lb. 10.54 oz.	3 lb. 13.46 oz.
	At length 0.739	2 lb. 5.07 oz.	5 lb. 10.93 oz.

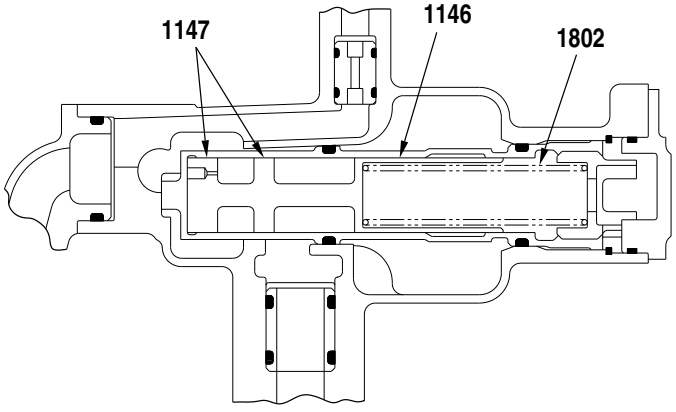
TABLE 206, Special Assembly

REF. NO.	Name	Limits Min.	Limits Max.
1920	Lapping of Oil Filter Bypass Valve		
	(1) Lap face of oil filter bypass valve to obtain 360 degrees contact.		





SECTION B–B



SECTION A–A

C111937

Fits, Clearances and Torque Loadings
Figure 206

CHECK VALVES AND TUBES (JT15D-5R) - DESCRIPTION AND OPERATION

1. Check Valves

The engine oil system contains two check valve assemblies, one each in the pressure and scavenge oil lines. Each check valve assembly is comprised of a housing, a check valve, a helical compression spring and spring seat, preformed packings and a retaining ring to secure the parts.

The assembled check valves are installed in the oil filter housing in the pressure and scavenge line ports. Pressure and scavenge oil is fed to and from the oil pump via transfer tubes and a coupling which secures to the oil filter housing.

The two check valves are held normally open by the operating pressure in the oil system. When the engine is not running, gravitational oil pressure against the check valve face compresses the spring and the check valve closes under the load. This allows oil system components, such as the oil filter and external transfer tubes downstream of the check valves, to be removed for servicing without draining the oil tank.

CHECK VALVES AND TUBES (JT15D-5R) - MAINTENANCE PRACTICES

1. General

   A. The following describes and removal and installation procedures for the check valves, check valve coupling and transfer tubes.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Engine Lubricating Oil

3. Special Tools

   The special tools listed below are used in the following procedures.

Tool No.	Name
PWC31680	Puller
PWC32396-400	Jackscrew

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal of Check Valves (Ref. Fig. 201)

      (1) Drain oil tank (Ref. 72-00-00, SERVICING).

      (2) Remove two retaining rings (15) and (18) securing oil transfer tubes (17) and (20) to coupling assembly (11). Push tubes into coupling, ensuring that they are removed from ports on oil pump (21).

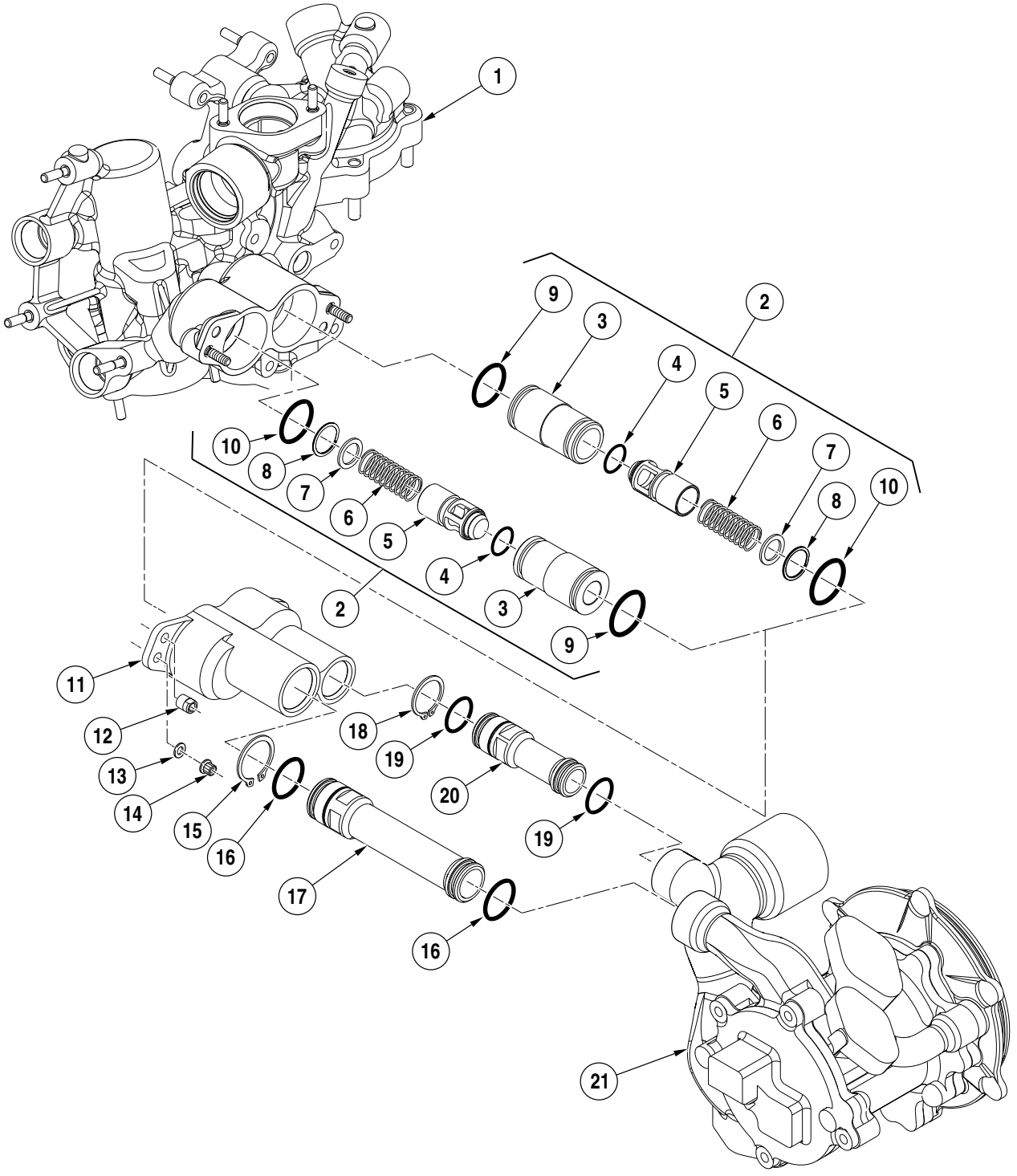
      (3) Remove the oil pump (Ref. 72-60-02 AGB EXTERNALS AND OIL PUMP-MAINTENANCE PRACTICES).

         NOTE: If the oil filter housing is already removed, it is not necessary to remove the oil pump.

      (4) Remove the two self-locking nuts (14) and washers (13) that attach the coupling assembly (11) to the oil filter housing assembly (1).

      (5) If necessary, use jackscrews (PWC32396-400) in the jacking inserts (12) and remove the coupling assembly (11).

      (6) Remove oil transfer tubes (17) and (20) from coupling assembly (11). Remove the preformed packings (16) and (19) from the transfer tubes. Discard the preformed packings.



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Removal/Installation - Oil Check Valves
Figure 201

Key to Figure 201

1. Oil Filter Housing
2. Check Valve Assembly
3. Check Valve Housing
4. Preformed Packing
5. Check Valve
6. Spring
7. Spring Seat
8. Retaining Ring
9. Preformed Packing
10. Preformed Packing
11. Coupling Assembly
12. Jacking Insert
13. Washer
14. Self-locking Nut
15. Retaining Ring
16. Preformed Packing
17. Oil Transfer Tube
18. Retaining Ring
19. Preformed Packing
20. Oil Transfer Tube
21. Oil Pump

(7) Remove the check valve assemblies (2) from oil filter housing assembly (1) using puller (PWC31680).

(8) Compress springs (6) and remove retaining rings (8) and spring seats (7). Separate check valves (5) from check valve housings (3). Remove and discard all preformed packings.

(9) Keep check valve assemblies in separate sets. Do not mix parts from different assemblies.

B. Installation of Check Valves (Ref. Fig. 201)

(1) Apply a light film of oil (PWC03-001) to preformed packings (4), (9), (10), (16), and (19).

(2) Install new preformed packings (4) in grooves of check valves (5).

CAUTION: TO ENSURE PRESSURE OIL TO, AND BYPASS OIL FROM THE OIL FILTER, INSTALL VALVES AS SHOWN ON FIGURE 201.

(3) Insert check valves (5) into respective check valve housings (3).

(4) Put the springs (6) in the check valves (5). Compress springs (6) and install spring seats (7) and retaining rings (8).

(5) Do a static oil leak test on both check valve assemblies as follows (Ref. Fig. 202):

(a) Install assembled check valve in locally fabricated tool.

(b) Secure check valve in clear plastic tube with hose clamp.

(c) Fill tube with engine oil (Ref. SB7001) to a level two inches above check valve.

(d) Prime check valve to release trapped air.

(e) Remove residual oil and ensure no oil leak from check valve.

(f) Fill tube with engine oil to a level 16 inches above check valve. Let check valve assembly remain under static oil leak test for two hours minimum. No oil leakage is permitted.

(g) If check valve assembly fails test, disassemble check valve (Ref. Subpara. 5.A.), discard preformed packing, and clean and inspect seats of check valve housing (14, Fig. 201) and check valve (13).

(h) If no defects are found, install new preformed packing on check valve and reassemble (Ref. Subpara. 5.B.).

(i) Repeat static oil leak test (Ref. step (a)). Reject check valve assembly if check valve assembly fails second leak test.

(6) Install check valve and valve housing as follows:

(a) Install new preformed packings (9) and (10) on each check valve housing.

(b) Install check valve assemblies in the oil filter housing (1).

(c) Install the coupling assembly (11) on the oil filter housing (1) with the washers (13) and nuts (14). Torque the nuts (14) 32 to 36 lbf.in.

(d) Install new preformed packings (16) and (19) on ends of oil transfer tubes (17) and (20).

(e) Insert and push oil transfer tubes into coupling assembly (11).

(f) Install the oil pump on the accessory gearbox (Ref. 72-60-02, AGB EXTERNALS AND OIL PUMP- MAINTENANCE PRACTICES)

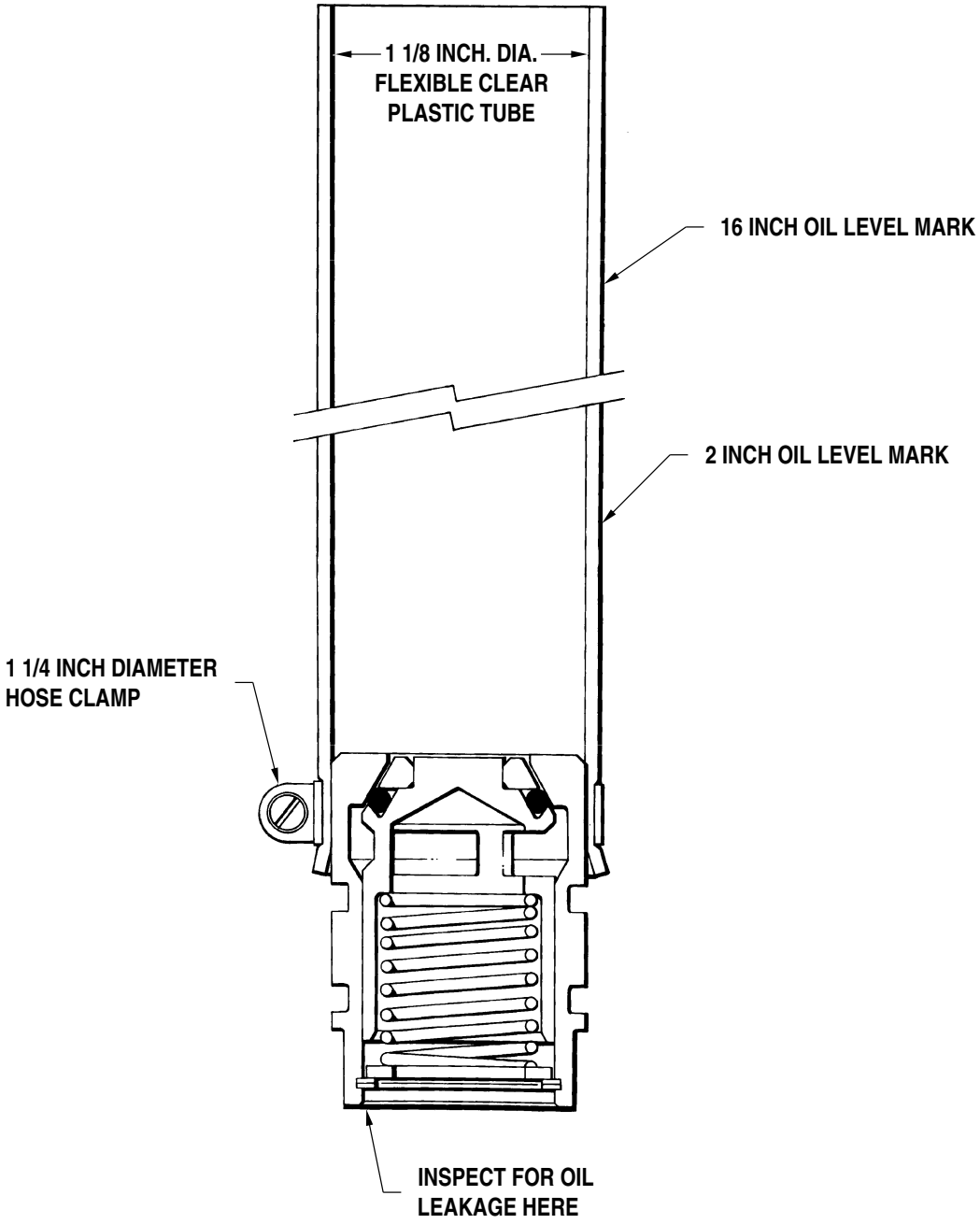
(g) Lightly pull oil transfer tubes from coupling assembly and insert into oil pump bosses.

(h) Install the retaining rings (15) and (18) on the oil transfer tubes (17) and (20).

(i) Refill oil tank (Ref. 72-00-00, SERVICING).

6. Fits, Clearances and Torque Loadings

A. Refer to Tables 201 and 203, and to Figure 203.



Typical C20269A

Static Oil Leak Test
Figure 202

TABLE 201, FITS AND CLEARANCES

REF. NO.	Name	Dim. for Ref. (inches) Min.	Dim. for Ref. (inches) Max.	Limits (inches) Min.	Limits (inches) Max.	Limits (inches) Replace
1149	Valve, Oil Check	0.8720	0.8725	0.0015	0.0030	0.005
	Housing, Check Valve	0.8740	0.8750			

TABLE 202, TORQUE AND STRETCH

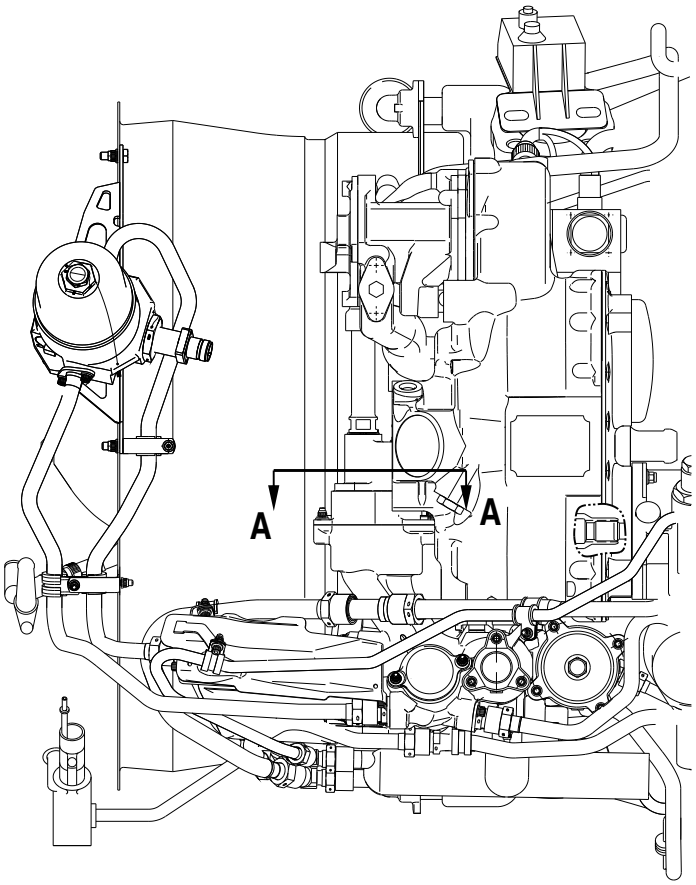
REF. NO.	Name	Limits Min.	Limits Max.
	Not Applicable		

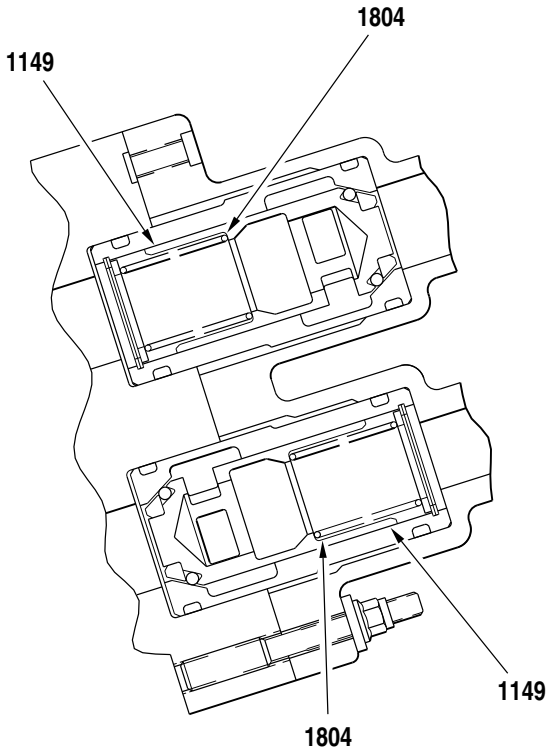
TABLE 203, SPRING PRESSURE

REF. NO.	Name	Limits Min.	Limits Max.
1804	Spring, Oil Check Valve		
	At length 0.854	1 lb. 6.0 oz.	1 lb. 8.0 oz.
	At length 0.665	2 lb. 0 oz.	2 lb. 4 oz.

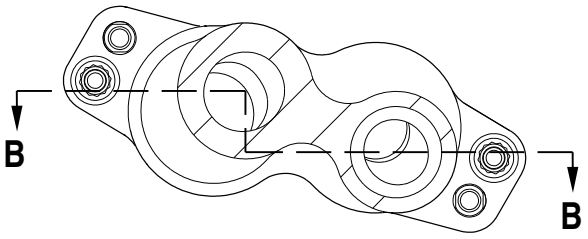
TABLE 204, SPECIAL ASSEMBLY

REF. NO.	Name	Limits Min.	Limits Max.
	Not Applicable		





SECTION **B–B**



SECTION **A–A**

C111938

Fits, Clearances and Torque Loadings
Figure 203

EXTERNAL PRESSURE OIL TUBES (JT15D-5R) - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the external pressure oil tubes.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Engine Lubricating Oil
PWC05-061	Crocus Cloth
PWC06-009	Anti-Seize Compound
PWC11-021	Carbon Remover Compound
PWC11-027	Petroleum Solvent

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal of No. 1, 2, 3 and 4 Bearings Pressure Oil Tubes (Ref. Fig. 201)

      (1) Remove the No. 4 bearing pressure oil tube (1) as follows:

         (a) Remove the two nuts (6), washers (5), and bolts (4) that attach the No. 4 bearing pressure oil tube (1) and the bracket (2) to the boss (3).

         (b) Remove the nut (12), spacer (10), and bolt (11) that attach the clamp (8) to the clamp (9).

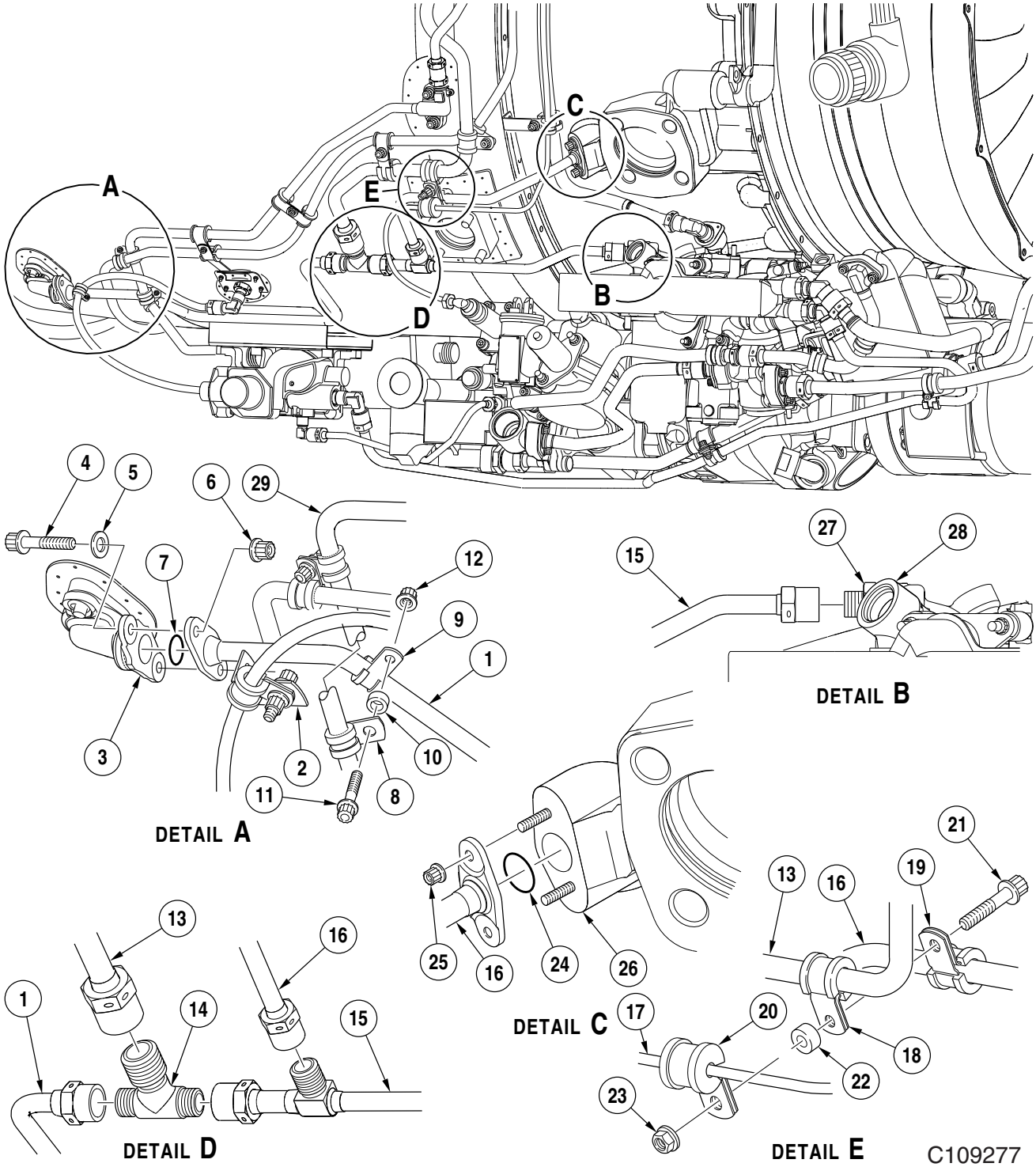
         (c) Cut the lockwire and disconnect the No. 4 bearing pressure oil tube (1) from the tee fitting (14).

         (d) Remove the No. 4 bearing pressure oil tube (1). Remove and discard the preformed packing (7) from the tube.

      (2) Remove the No. 1, 2, 3 bearings pressure oil tube (16) as follows:

         (a) Remove the nut (23), spacer (22), and bolt (21) that attach the clamp (19) to the clamps (18) and (20).

         (b) Cut the lockwire and disconnect the No. 1, 2, 3 bearings pressure oil tube (16) from the tee fitting on the pressure oil tube (15).



Removal/Installation - No 1, 2, 3 and 4 Bearings Pressure Oil Tubes
Figure 201

Key to Figure 201

1. No. 4 Bearing Pressure Oil Tube
2. Bracket
3. Boss (Ref.)
4. Bolt
5. Washer
6. Self-locking Nut
7. Preformed Packing
8. Clamp
9. Clamp
10. Spacer
11. Bolt
12. Self-locking Nut
13. Oil Pressure Tube
14. Tee Fitting
15. Oil Pressure Tube
16. No. 1, 2, 3 Bearings Pressure Oil Tube
17. Electrical Wiring Harness
18. Clamp
19. Clamp
20. Clamp
21. Bolt
22. Spacer
23. Self-locking Nut
24. Preformed Packing
25. Self-locking Nut
26. Boss (Ref.)
27. Nipple Tube
28. Oil Filter Housing
29. Compressor Delivery Air Pressure Tube

(c) Remove the two nuts (25) that attach the No. 1, 2, 3 bearings pressure oil tube (16) to the boss (26).

(d) Remove the No. 1, 2, 3 bearings pressure oil tube (16). Remove and discard the preformed packing (24) from the tube.

(3) Remove the pressure oil tube (15) as follows:

(a) If applicable, cut the lockwire and disconnect the No. 1, 2, 3 bearings pressure oil tube (16) from the tee fitting on the pressure oil tube (15).

(b) Cut the lockwire and disconnect the pressure oil tube (15) from the tee fitting (14).

(c) Cut the lockwire and disconnect the pressure oil tube (15) from the nipple (27) on the oil filter housing (28).

(d) Remove the pressure oil tube (15).

(4) To remove the tee fitting (14) cut the lockwire and disconnect the anti-siphon pressure oil tube (13) from the tee fitting.

(5) Put protective caps and covers in all openings.

B. Installation of No. 1, 2, 3 and 4 Bearings Pressure Oil Tubes (Ref. Fig. 201)

(1) Remove the protective caps and covers from the openings.

(2) Apply a light film of oil (PWC03-001) to preformed packings (7) and (24).

(3) Apply anti-seize (PWC06-009) compound to the tube connections on the tee fitting (14), pressure oil tube (15) tee fitting, and the nipple (27) on the oil filter housing (28).

(4) Connect the anti-siphon pressure oil tube (13) to the tee fitting (14). Torque the tube coupling nut 340 to 375 lbf.in.

(5) Install the pressure oil tube (15) as follows:

(a) Connect the pressure oil tube (15) to the nipple (27) on the oil filter housing (28). Torque the tube coupling nut 200 to 225 lbf.in.

(b) Connect the pressure oil tube (15) to the tee fitting (14). Torque the tube coupling nut 225 to 250 lbf.in.

(c) Connect the No. 1, 2, 3 bearings pressure oil tube (16) to the tee fitting on the pressure oil tube (15). Torque the tube coupling nut 200 to 225 lbf.in.

(d) Lockwire the pressure oil tube (15) and No. 1, 2, 3 bearings pressure oil tube (16) coupling nuts .

(6) Install the No. 1, 2, 3 bearings pressure oil tube (16) as follows:

(a) If applicable, connect the No. 1, 2, 3 bearings pressure oil tube (16) to the tee fitting on the pressure oil tube (15). Torque the tube coupling nut 200 to 225 lbf.in.

(b) Install a new preformed packing (24) on the No. 1, 2, 3 bearings pressure oil tube (16).

(c) Attach the No. 1, 2, 3 bearings pressure oil tube (16) to the boss (26) with the two nuts (25). Torque the nuts 32 to 36 lbf.in.

(d) Attach the clamp (19) to the clamps (18) and (20) with the nut (23), spacer (22), and bolt (21).Torque the nuts 36 to 40 lbf.in.

(e) Lockwire the No. 1, 2, 3 bearings pressure oil tube (16) coupling nut to the tee fitting on the pressure oil tube (15).

(7) Install the No. 4 bearing pressure oil tube (1) as follows:

(a) Install a new preformed packing (7) on the No. 4 bearing pressure oil tube (1).

(b) Attach the No. 4 bearing pressure oil tube (1) and the bracket (2) to the boss (3) with the two nuts (6), washer (5), and bolts (4). Torque the nuts 36 to 40 lbf.in.

(c) Connect the No. 4 bearing pressure oil tube (1) to the tee fitting (14). Torque the tube coupling nut 200 to 225 lbf.in.

(d) Attach the clamp (8) to the clamp (9) with the nut (12), spacer (10), and bolt (11). Torque the nuts 36 to 40 lbf.in.

(e) Lockwire the No. 4 bearing pressure oil tube (1) coupling nut to the tee fitting (14).

C. Removal of the Anti-Siphon Pressure Oil Tubes (Ref. Fig. 202)

(1) Remove the nut (7) and bolt (6) that attach the clamp (5) to the clamp (4).

(2) Remove the nut (13), bolt (11), and spacer (12) that attach the clamp (8) to the clamps (9) and (10).

(3) Remove the nut (18) and bolt (17) that attach the clamp (16) to the clamp (15).

(4) In two places, remove the nuts (22) and bolts (23) that attach the clamps (20) to the clamps (21).

(5) In two places, remove the nuts (29) and bolts (28) that attach the clamps (27) to the clamps (26) and (25).

(6) Remove the nut (34) and bolt (33) that attach the clamp (32) to the clamp (31).

(7) Remove the nut (43), spacer (44) and bolt (42) that attach the clamp (40) to the clamp (41).

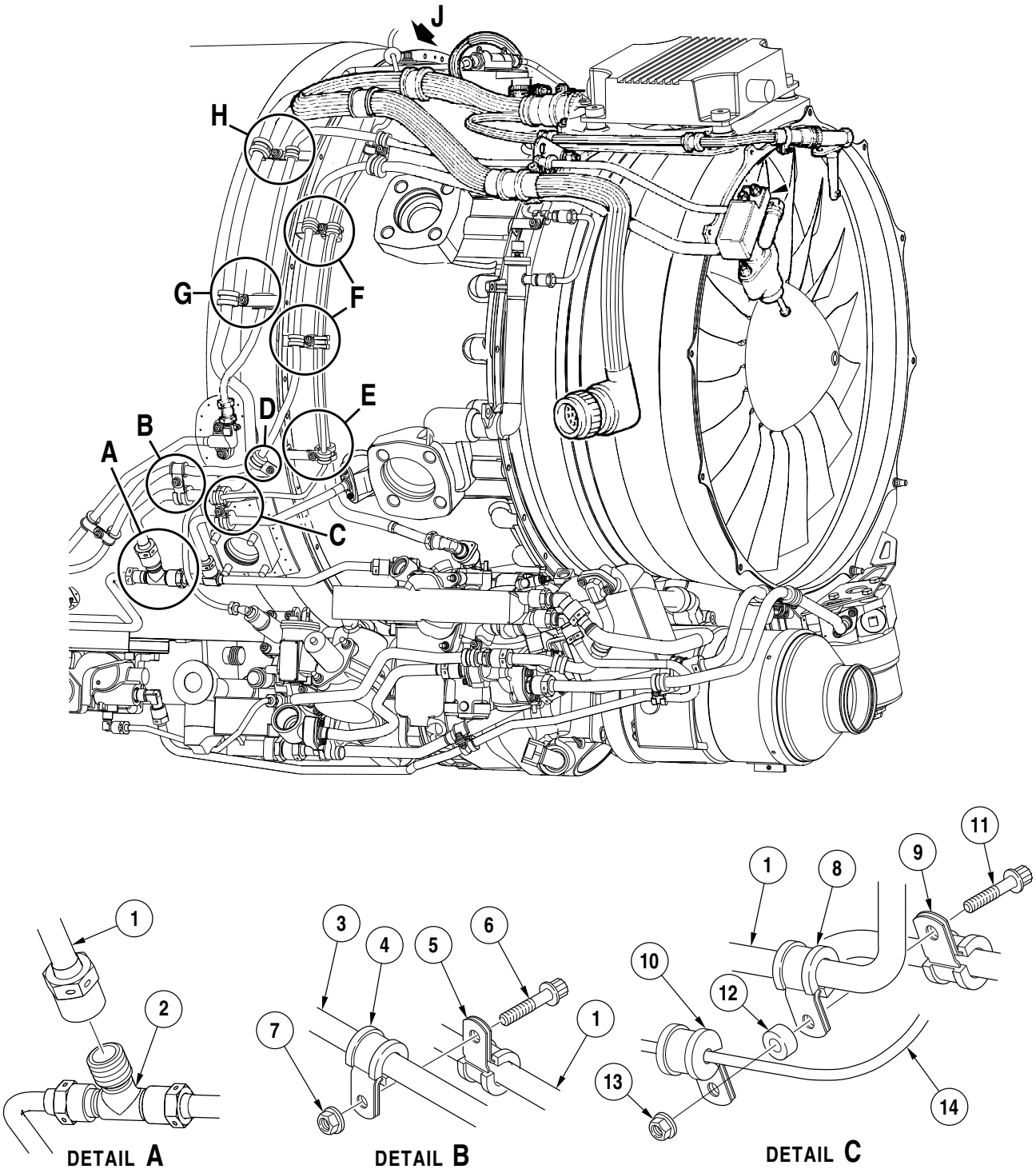
(8) Disconnect the anti-siphon bleed tube (38) from the tee fitting on the anti-siphon pressure oil tube (1) and the oil return adapter (39). Remove the anti-siphon bleed tube (38).

(9) Disconnect the anti-siphon pressure oil tube (1) from the tee fitting (2) and the elbow (36) on the oil filter housing (37). Remove the anti-siphon pressure oil tube (1).

(10) Put protective caps and covers on all openings.

D. Installation of the Anti-Siphon Pressure Oil Tubes (Ref. Fig. 202)

(1) Remove the protective caps and covers from the openings.

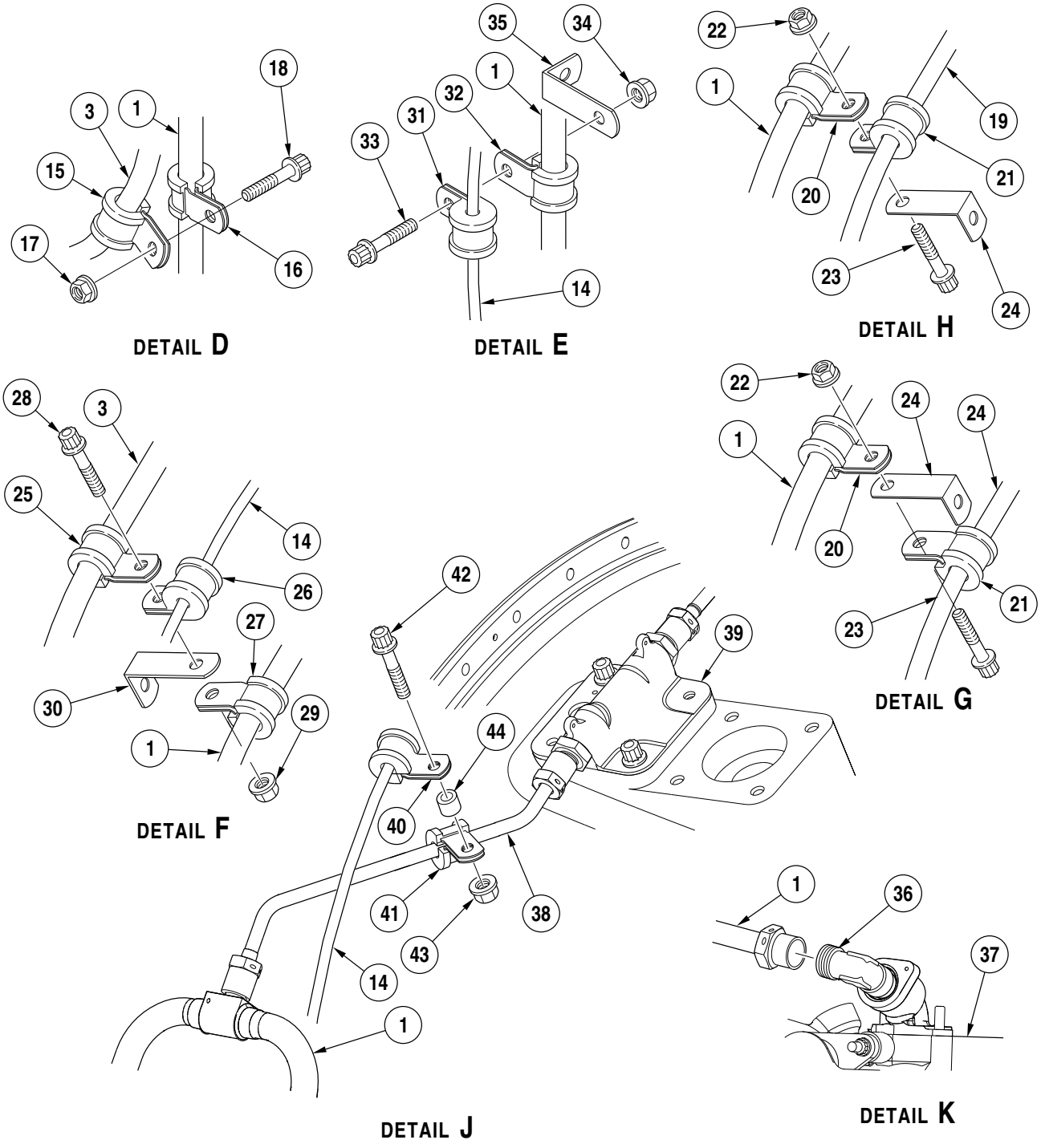


C109238

Removal/Installation - Anti-Siphon Pressure Oil Tubes
Figure 202 (Sheet 1 of 2)

Key to Figure 202

1. Anti-Siphon Pressure Oil Tube
2. Tee Fitting
3. TI Thermocouple Wiring Harness
4. Clamp
5. Clamp
6. Bolt
7. Nut
8. Clamp
9. Clamp
10. Clamp
11. Bolt
12. Spacer
13. Nut
14. Electrical Wiring Harness
15. Clamp
16. Clamp
17. Bolt
18. Nut
19. Anti-Icing Air Pressure Tube
20. Clamp
21. Clamp
22. Nut
23. Bolt
24. Bracket
25. Clamp
26. Clamp
27. Clamp
28. Bolt
29. Nut
30. Bracket
31. Clamp
32. Clamp
33. Bolt
34. Nut
35. Bracket
36. Elbow
37. Oil Filter Housing
38. Anti-siphon Bleed Tube
39. Oil Return Adapter
40. Clamp
41. Clamp
42. Bolt
43. Nut
44. Spacer



C109239

Removal/Installation - Anti-Siphon Pressure Oil Tubes
Figure 202 (Sheet 2)

(2) Apply anti-seize (PWC06-009) compound to the tube connections on the tee fitting (2), anti-siphon pressure oil tube (1) tee fitting, oil return adapter (39), and elbow (36) on the oil filter housing (37).

(3) Connect the anti-siphon pressure oil tube (1) to the tee fitting (2). Torque the tube coupling nut 340 to 375 lbf.in.

(4) Connect the anti-siphon pressure oil tube (1) to the elbow (36) on the oil filter housing (37). Torque the tube coupling nut 225 to 250 lbf.in.

(5) Connect the anti-siphon bleed tube (38) to the tee fitting on the anti-siphon pressure oil tube (1) and the oil return adapter (39). Torque the tube coupling nuts 65 to 75 lbf.in.

(6) Attach the anti-siphon bleed tube (38) to the electrical wiring harness (14) with the clamps (40) and (41), nut (43), spacer (44) and bolt (42). Torque the nut 36 to 40 lbf.in.

(7) Attach the anti-siphon pressure oil tube (1) and the electrical wiring harness (14) to the bracket (35) with the clamps (32) and (31), bolt (33), and nut (34). Torque the nut 36 to 40 lbf.in.

(8) In two places, attach the anti-siphon pressure oil tube (1), electrical wiring harness (14) and TI thermocouple wiring harness (3) to the bracket (35) with the clamps (32) and (31), bolt (33), and nut (34). Torque the nut 36 to 40 lbf.in.

(9) In two places, attach the anti-siphon pressure oil tube (1) and anti-icing air pressure tube (19) to the bracket (24) with the clamps (20) and (21), bolt (23), and nut (22). Torque the nut 36 to 40 lbf.in.

(10) Attach the anti-siphon pressure oil tube (1) to the TI thermocouple wiring harness (3) with the clamps (16) and (15), bolt (17), and nut (18). Torque the nut 36 to 40 lbf.in.

(11) Attach the anti-siphon pressure oil tube (1) to the electrical wiring harness (14) and the Nos.1, 2, 3 bearings pressure oil tube with clamps (8), (9) and (10), bolt (11), spacer (12) and nut (13). Torque the nut 36 to 40 lbf.in.

(12) Attach the anti-siphon pressure oil tube (1) to the TI thermocouple wiring harness (3) with the clamps (5) and (6), bolt (6), and nut (7). Torque the nut 36 to 40 lbf.in.

6. Inspection/Check

A. Procedure

(1) Inspect tube visually for damage as follows:

(a) Cracks - Cracked tube must be replaced. No repair is permitted.

(b) Scratches - Minor scratches having no appreciable depth are acceptable. Scratches to a depth of 0.005 inch must be blended out. Replace tube with scratches over 0.005 inch deep.

(c) Nicks - Individual nicks up to 0.062 inch long by 0.010 inch wide and 0.003 inch deep can be ignored. Nicks to a maximum depth of 0.005 inch must be blended out to remove sharp edges. Replace tubing with nicks greater than 0.005 inch deep.

(d) Dents - Round bottom dents on straight sections of tube are permitted provided the length and depth are not greater than 10 percent of the normal outside diameter of tube. No more than one dent to maximum depth per 12 inch length of tube is acceptable. Dents on tube bends, which cause restriction by flattening and local weakening, are not acceptable.

(e) Pitting - Minor isolated pitting up to 0.003 inch deep is acceptable. Clusters of pitting should be blended out to a maximum depth of 0.005 inch. Tubing must be replaced if pitting exceeds 0.005 inch deep.

(f) Corrosion - Staining on tube and surface corrosion is acceptable if removable by light polishing with crocus cloth (PWC05-061)and oil (PWC03-001).

7. Cleaning/Painting

A. Procedure

(1) Clean tubing as follows:

(a) Soak external oil tubing in cold carbon remover (PWC11-021) for two hours at room temperature.

(b) Rinse tube exterior with petroleum solvent (PWC11-027).

(c) Pressure flush tube interior with petroleum solvent and dry interior and exterior with compressed air.

EXTERNAL SCAVENGE OIL TUBES (JT15D-5R) - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the external scavenge oil tubes.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC05-061	Crocus Cloth
PWC03-001	Engine Lubricating Oil
PWC06-009	Anti-Seize Compound
PWC11-021	Carbon Remover Compound
PWC11-027	Petroleum Solvent

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal of No. 4 Bearing Oil Scavenge and Oil Return-to-Tank Tubes (Ref. Fig. 201)

      (1) Remove self-locking nut (18) and bolt (14) securing loop clamp (15) to anti-icing tube loop clamp (17) on anti-icing air delivery tube.

      (2) Remove lockwire and disconnect coupling nut (4) on oil-to-tank tube (3) from adapter (5) on oil pump.

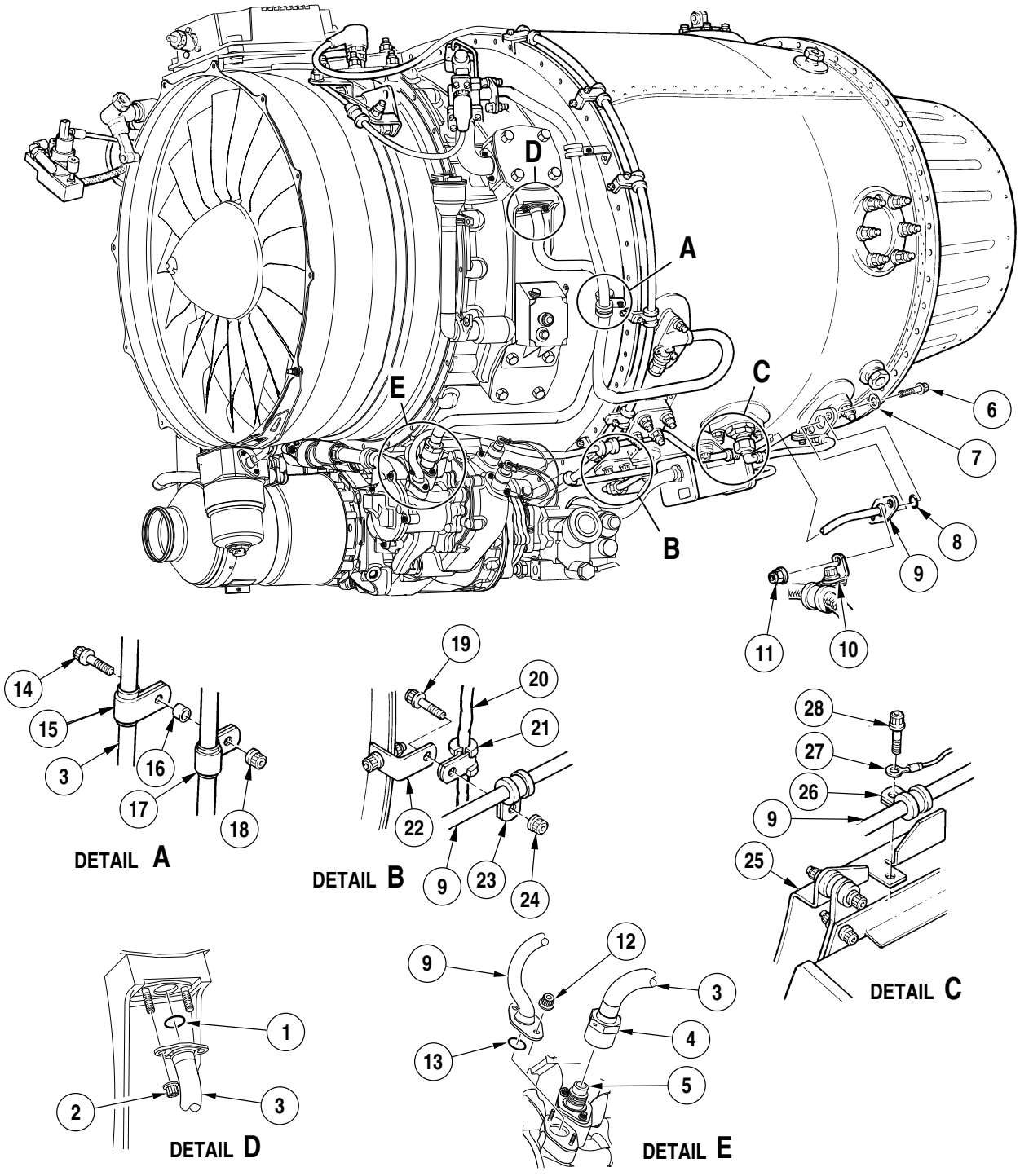
      (3) Remove two self-locking nuts (2) securing flanged end of oil-to-tank tube (3) to intermediate case. Remove tube and discard packing. Remove loop clamp (15) from tube.

      (4) Remove self-locking nuts (24) and bolt (19) securing loop clamps (23) and (21) to angle bracket (22).

      (5) Remove bolt (28) securing loop clamp (26) on scavenge oil tube (9) to ignition exciter bracket (25). Also remove ground terminal (27).

      (6) Remove two self-locking nuts (12) securing flanged end of No. 4 bearing scavenge oil tube (9) to oil pump.

      (7) Remove two self-locking nuts (11), bolts (6) and washers (7) securing No. 4 bearing scavenge oil tube assembly (9) and angle bracket (10) to flanged elbow at rear of bypass duct.



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Removal/Installation - Oil Scavenge and Return-to-Tank Tubes
Figure 201

Key to Figure 201

1. Preformed Packing
2. Self-locking Nut
3. Oil Tube - Return to Tank
4. Tube Coupling Nut
5. Adapter
6. Bolt
7. Washer
8. Preformed Packing
9. No.4 Bearing Oil Scavenge Tube
10. Angle Bracket
11. Self-locking Nut
12. Self-locking Nut
13. Preformed Packing
14. Bolt
15. Loop Clamp
16. Spacer
17. Loop Clamp
18. Self-locking Nut
19. Bolt
20. Engine Wiring Harness
21. Loop Clamp Assembly
22. Angle Bracket
23. Loop Clamp
24. Self-locking Nut
25. Ignition Exciter Mount Bracket
26. Loop Clamp
27. Ground Terminal Assembly
28. Bolt

(8) Remove tube (9) and two preformed packings (8) and (13). Discard preformed packings. Remove two loop clamps (23) and (26) from tube.

(9) Put protective caps and covers in all openings.

B. Installation of No. 4 Bearing Oil Scavenge and Oil Return-to-Tank Tubes (Ref. Fig. 201)

(1) Remove the protective caps and covers from the openings.

(2) Apply a light film of oil (PWC03-001) to preformed packings (1), (8), and (13).

(3) Apply anti-seize (PWC06-009) compound to the adapter (5).

(4) Install two new preformed packings (8) and (13) and two loop clamps (23) and (26) on No. 4 bearing scavenge oil tube (9).

(5) Secure No. 4 bearing scavenge oil tube as follows:

(a) Secure front flange of tube (9) to studs on oil pump mounting boss with two self-locking nuts (12). Tighten but do not torque nuts.

(b) Secure rear flange of tube (9) with angle bracket (10) to flanged elbow with two washers (7), bolts (6) and self-locking nuts (11).

(c) Torque nuts (11) to 36 to 40 lbf.in.

(d) Torque nuts (12) to 32 to 36 lbf.in.

(6) Secure ground terminal (27) and loop clamp (26) to ignition exciter mounting bracket with bolt (28). Torque bolt 32 to 36 lb.in.

(7) Secure loop clamps (21) and (23) to angle bracket (22) on flange B with bolt (19) and self-locking nut (24). Tighten and torque nut to 36 to 40 lbf.in.

(8) Install loop clamp assembly (15) on oil return-to-tank tube (3).

(9) Install preformed packing (1) on oil-to-tank tube (3) and install tube as follows:

(a) Secure flanged end of tube (3) to intermediate case studs with two self-locking nuts (2). Tighten but do not torque nuts.

(b) Connect coupling nut (4) on tube (3) to adapter (5) on oil pump.

(c) Torque self-locking nuts (2) to 32 to 36 lbf.in.

(d) Torque coupling nut (4) to 475 to 525 lbf.in.

(10) Secure loop clamps (15) and (17) and spacer (16) with bolt (14) and self-locking nut (18). Tighten and torque nut to 36 to 40 lbf.in.

6. Inspection/Check

A. Procedure

(1) Inspect tube visually for damage as follows:

(a) Cracks - Cracked tube must be replaced. No repair is permitted.

(b) Scratches - Minor scratches having no appreciable depth are acceptable. Scratches to a depth of 0.005 inch must be blended out. Replace tube with scratches over 0.005 inch deep.

(c) Nicks - Individual nicks up to 0.062 inch long by 0.010 inch wide and 0.003 inch deep can be ignored. Nicks to a maximum depth of 0.005 inch must be blended out to remove sharp edges. Replace tubing with nicks greater than 0.005 inch deep.

(d) Dents - Round bottom dents on straight sections of tube are permitted provided the length and depth are not greater than 10 percent of the normal outside diameter of tube. No more than one dent to maximum depth per 12 inch length of tube is acceptable. Dents on tube bends, which cause restriction by flattening and local weakening, are not acceptable.

(e) Pitting - Minor isolated pitting up to 0.003 inch deep is acceptable. Clusters of pitting should be blended out to a maximum depth of 0.005 inch. Tubing must be replaced if pitting exceeds 0.005 inch deep.

(f) Corrosion - Staining on tube and surface corrosion is acceptable if removable by light polishing with crocus cloth (PWC03-001) and oil (PWC05-061).

7. Cleaning/Painting

A. Procedure

(1) Clean tubing as follows:

(a) Soak external oil tubing in cold carbon remover (PWC11-021) for two hours at room temperature.

(b) Rinse tube exterior with petroleum solvent (PWC11-027).

(c) Pressure flush tube interior with petroleum solvent and dry interior and exterior with compressed air.

LIST OF EFFECTIVE PAGES

CHAPTER SECTION	PAGE	DATE
LEP	1	May 13/2013
	2 blank	May 13/2013
Contents	1	May 13/2013
	2	May 13/2013
	3	May 13/2013
	4	May 13/2013
79-30-00	1	Oct 06/2006
Description and	2	Oct 06/2006
Operation	3	Oct 06/2006
	4 blank	Oct 06/2006
79-30-01	201	Oct 22/99
Maintenance	202	Oct 22/99
Practices	203	Oct 22/99
	204 blank	Oct 22/99
79-30-02	201	Oct 06/2006
Maintenance	202	Oct 06/2006
Practices	203	Oct 06/2006
	204	Oct 06/2006
	205	Oct 06/2006
	206	Oct 06/2006
	207	Oct 06/2006
	208 blank	Oct 06/2006
79-30-03	201	Oct 06/2006
Maintenance	202	Oct 06/2006
Practices	203	Oct 06/2006
	204	Oct 06/2006
	205	Oct 06/2006
	206	Oct 06/2006
	207	Oct 06/2006
	208 blank	Oct 06/2006
79-30-04	201	Oct 06/2006
Maintenance	202	Oct 06/2006
Practices	203	Oct 06/2006
	204	Oct 06/2006
	205	Oct 06/2006
	206	Oct 06/2006
	207	Oct 06/2006
	208 blank	Oct 06/2006
79-30-05	201	May 13/2013
Maintenance	202	May 13/2013
Practices	203	May 13/2013
	204	May 13/2013
	205	May 13/2013
	206	May 13/2013
	207	May 13/2013
	208	May 13/2013
	209	May 13/2013
	210	May 13/2013
	211	May 13/2013
	212	May 13/2013

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TABLE OF CONTENTS

SUBJECT	PAGE
OIL INDICATING - DESCRIPTION AND OPERATION	**79-30-00**
1. Description	1
A. Oil Tank	1
B. Oil Filter Housing	1
C. JT15D-5 (Post-SB7596) and JT15D-5R Remote Oil Indicator Panel	1
D. JT15D-5 (Post-SB7596) and JT15D-5R Remote Oil Indicator	1
E. Chip Detection System	2
OIL FILLER-NECK AND OIL FILLER CAP- MAINTENANCE PRACTICES	**79-30-01**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal of Oil Filler Cap)	201
B. Installation of Oil Filler Cap)	201
R/O/L INDICATOR PANEL- MAINTENANCE PRACTICES	**79-30-02**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal of Remote Oil Level Indicator Panel	201
B. Installation of Remote Oil Level Indicator Panel	201
6. Cleaning	206
A. Remote Oil Level Indicator Panel	206

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
R/O/L INDICATOR PANEL- MAINTENANCE PRACTICES (Cont'd)	**79-30-02**
7. Inspection/Check	206
A. Remote Oil Level Indicator Panel - Visual Checks	206
B. Remote Oil Level Indicator Panel - Functional Checks	207
8. Repair	207
A. Remote Oil level Indicator Panel	207
R/O/L INDICATOR AND HOUSING - MAINTENANCE PRACTICES	**79-30-03**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal of Remote Oil Indicator and Housing	201
B. Installation of Remote Oil Indicator and Housing	205
6. Cleaning	205
A. Remote Oil Level Indicator	205
7. Inspection/Check	206
A. Remote Oil Level Indicator - Visual Checks	206
B. Remote Oil Level Indicator - Electrical Checks	206
C. Remote Oil Level Indicator - Operational and Leakage Checks	206
8. Repair	207
A. Remote Oil Level Indicator	207
R/O/L INDICATOR VENT TUBES - MAINTENANCE PRACTICES	**79-30-04**
1. General	201
2. Consumable Materials	201
3. Special Tools	201

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The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
R/O/L INDICATOR VENT TUBES - MAINTENANCE PRACTICES (Cont'd)	**79-30-04**
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal of Remote Oil Level Indicator Vent Tubes	201
B. Installation of Remote Oil Level Indicator Vent Tubes	206
C. Relocation of Vent Tubes for Converting the Engine for Installation on Opposite Side of the Aircraft	206
6. Cleaning/Painting	207
A. Remote Oil Indicator Vent Tubes	207
7. Inspection/Check	207
A. Remote Oil Indicator Vent Tubes	207
CHIP DETECTION SYSTEM - MAINTENANCE PRACTICES	**79-30-05**
1. General	201
2. Consumable Materials	201
3. Special Tools	201
4. Fixtures, Equipment and Supplier Tools	201
5. Removal/Installation	201
A. Removal of Magnetic Chip Detector	201
B. Removal of Chip Detector Cable Assembly	201
C. Installation of Magnetic Chip Detector	209
D. Installation of Chip Detector Cable Assembly	209
E. Installation of Self-closing Valve	211
6. Inspection/Check	211
A. Inspection of Magnetic Chip Detector	211
B. Inspection of Chip Detector Cable Assembly	212
C. Inspection of Self-closing Valve	212

P&WC Proprietary Information. Subject to the restriction on the title page.
The export control classification with respect to this document is contained on the back of the title page.

TABLE OF CONTENTS

SUBJECT	PAGE
CHIP DETECTION SYSTEM - MAINTENANCE PRACTICES (Cont'd)	**79-30-05**
7. Adjustment/Test	212
A. Magnetic Chip Detector	212
B. Chip Detector Cable Assembly	212

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The export control classification with respect to this document is contained on the back of the title page.

OIL INDICATING - DESCRIPTION AND OPERATION

1. Description

A. Oil Tank

The oil tank is provided with a dipstick which is secured to, and forms an assembly with the oil tank filler cap. The oil level in the tank is equal to the level in the filler-neck and is indicated by the dipstick.

B. Oil Filter Housing

Threaded bosses on the oil filter housing provide for the mounting of airframe-supplied oil pressure and oil temperature transmitters which connect to their respective indicating systems. Refer to Airframe Maintenance Manual.

C. JT15D-5 (Post-SB7596) and JT15D-5R Remote Oil Indicator Panel (Ref. Fig. 1)

A panel mounted on the outboard side of the engine houses circuitry which allows ground personnel to check engine oil level (Ref. 79-30-02).

A panel-mounted electrical connector accepts an unacceptably low oil level electrical signal from an airframe harness cable when the engine oil level is below the minimum required level. An OIL CHECK test button and an indicator lamp are provided. The lamp does not illuminate during engine operation. Power to the test button is supplied via the airframe wiring harness.

The indicator, which houses a green lamp with a press-to-test button, is used in conjunction with the red OIL CHECK button. The press-to-test feature is used to test the indicator lamp.

The upper indicator will illuminate green when the OIL CHECK button is pushed and the engine oil level is acceptable.

If the engine oil level is unacceptably low, the upper indicator will not illuminate when the OIL CHECK button is pressed.

D. JT15D-5 (Post-SB7596) and JT15D-5R Remote Oil Indicator

The remote oil indicator is an electrical probe which provides the remote oil indicator with a low oil level signal through an airframe wiring harness (Ref. 79-30-03).

The probe is installed in a housing which is mounted at the intermediate case forward flange, opposite to the oil filler neck. An airframe harness is secured to an electrical connector at the top of the probe, and a microswitch at the bottom of the probe provides a signal when the oil tank level is unacceptably low.

The base of the probe houses a float with a magnetic plate; the float is supported by engine oil. When the engine oil level is acceptable, the float is supported and electrical contact with the microswitch is maintained. When the engine oil level is unacceptably low, the float lowers, causing electrical contact with the microswitch to be broken. When this occurs, the normally open microswitch closes and a failure signal is made available to a test button on the remote oil indicator panel.

To prevent a false oil level indication, three interconnecting air vent tubes are installed to equalize air pressure in the remote oil indicator with air pressure in the oil tank (Ref. 79-30-04).

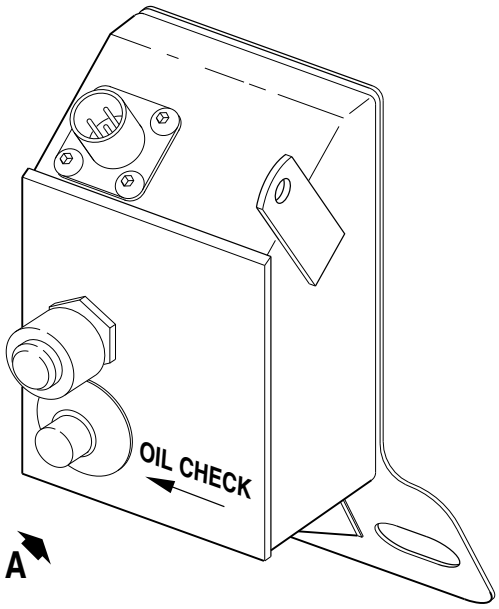
A tube leading from an elbow on top of the intermediate case connects with a second tube which branches right and left across the top of the engine. A third, U-shaped tube is used to connect the second tube with the remote oil indicator housing, the other end of the U-shaped tube is capped.

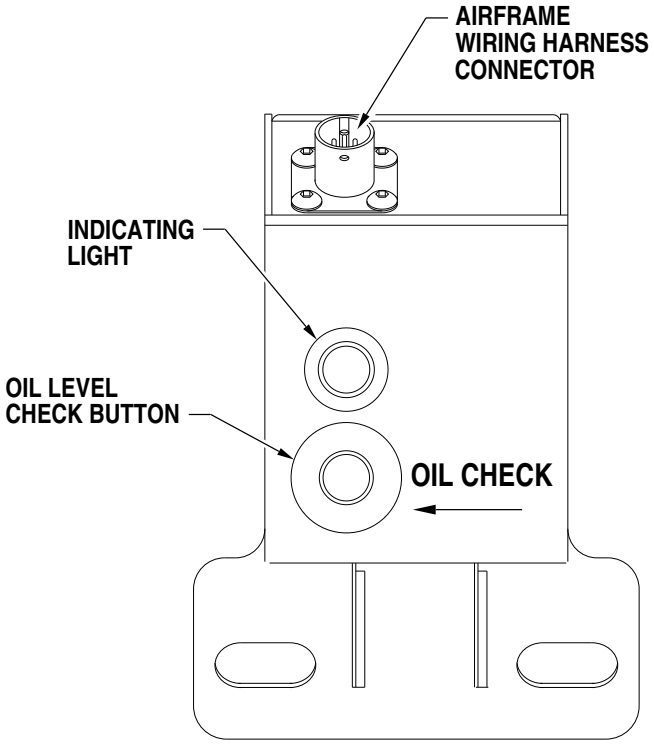
When an engine is being converted to a left or a right-hand engine, the remote oil indicator with the U-shaped tube and vent tube cap and the oil filler neck are removed and reinstalled at their opposite positions on the engine.

E. Chip Detection System

JT15D-5 (Post-SB7599 BS1191) and JT15D-5R (BS1221) engines incorporate a bayonet-style, two-pole magnetic chip detector with an electrical connector and a self-closing valve in the AGB drain bore (Ref. 79-30-05).

An electrical harness with a jack connector leading from the chip detector is provided for ground personnel to check for a completed chip detector circuit, indicating presence of metallic debris on chip detector poles.





VIEW A

C96903

Remote Oil Indicator Panel - Description
Figure 1

OIL FILLER-NECK AND OIL FILLER CAP- MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the oil filler-neck and oil filler cap.

2. Consumable Materials

   Not Applicable

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   The oil filler-neck is normally only removed at overhaul, for repair or when engines are converted for operation on opposite side of aircraft (Ref. 72-00-00, REMOVAL/INSTALLATION).

   Maintenance practices for the oil filler-neck assembly are generally confined to replacing the preformed packing on the filler cap and dipstick assembly.

   A. Removal of Oil Filler Cap (Ref. Fig. 201)

      (1) Unlock and remove assembly of oil filler cap (1) and dipstick (3) from oil filler-neck (4).

      (2) Remove preformed packing (2) and discard.

   B. Installation of Oil Filler Cap (Ref. Fig. 201)

      (1) Install new preformed packing (2) on oil filler cap (1) and dipstick (3) assembly.

      (2) Insert oil filler cap (1) and dipstick (3) assembly in oil filler-neck (4). Twist, turn and lock filler cap (1).

C19197

Oil Filler-Neck
Figure 201

Key to Figure 201

1. Oil Filler Cap
2. Preformed Packing
3. Dipstick
4. Oil Filler-Neck

R/O/L INDICATOR PANEL- MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the JT15D-5 (Post-SB7596) and JT15D-5R remote oil indicator panel.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC11-014B	Alcohol, Isopropyl

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal of Remote Oil Level Indicator Panel (Ref. Fig. 201)

      (1) Disconnect aircraft harness from electrical connector (9) (Ref. Aircraft Maintenance Manual).

      (2) Remove plug (5) from the chip detector cable (1).

      (3) Remove bolt (10) and nut (4) securing loop clamp (2) and plug assembly (5) to bracket (3).

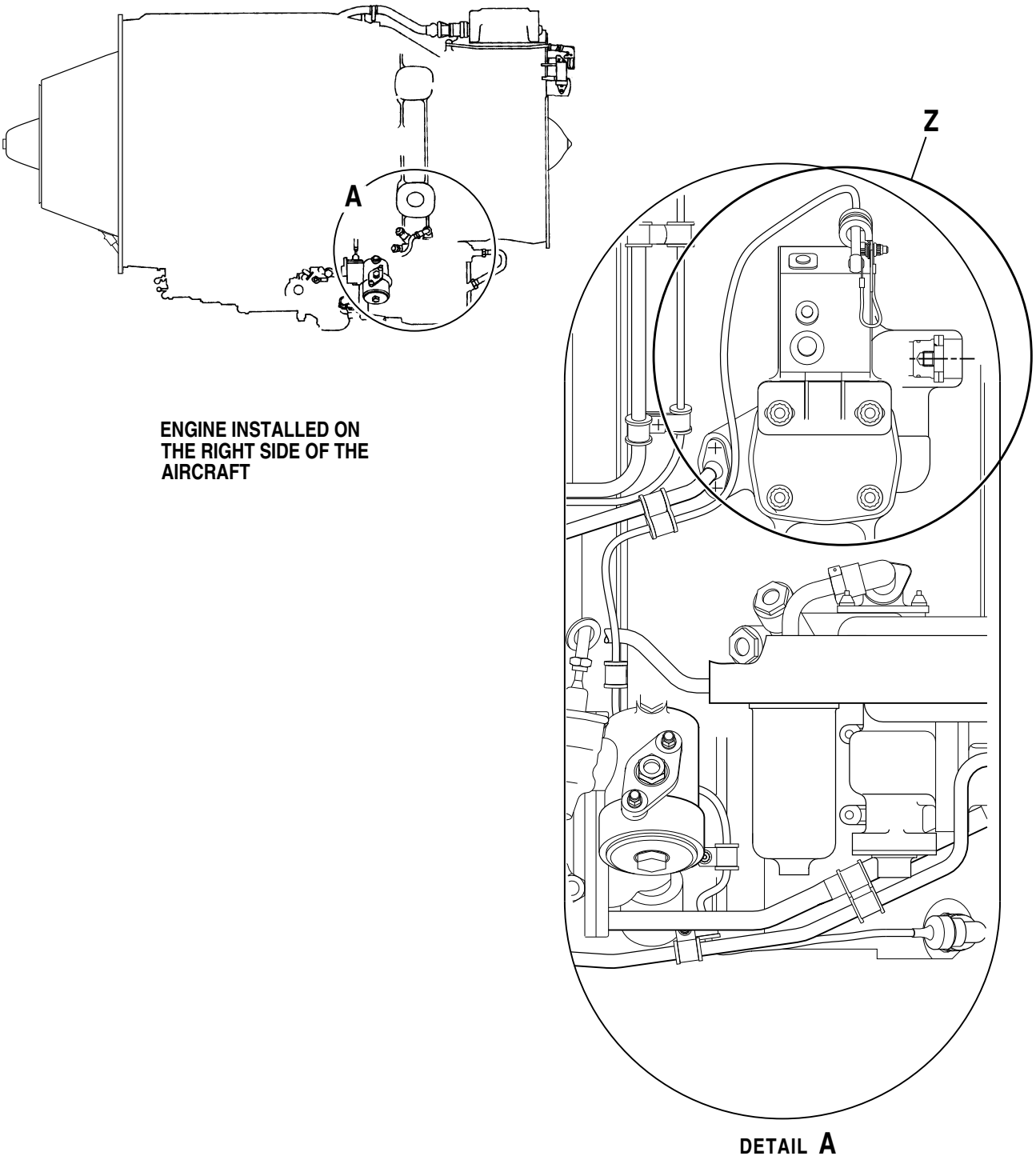
      (4) Remove two bolts (6) and washers (7) securing the remote oil level indicator panel (8) to the lower mount pad. Remove the panel and install a suitable cap on the exposed electrical connector.

      (5) If engine is being prepared for shipping container, refer to **Chapter 72-00-00, SERVICING: Installation of Engine in Shipping Container** for procedure for indicator panel.

   B. Installation of Remote Oil Level Indicator Panel (Ref. Fig. 201)

      NOTE: Remote oil indicator panel (8) must be installed on outboard side of engine.

      (1) Install remote oil indicator panel (7) on the lower outboard mount pad on intermediate case with slots of panel aligned with top holes in the mount pad.

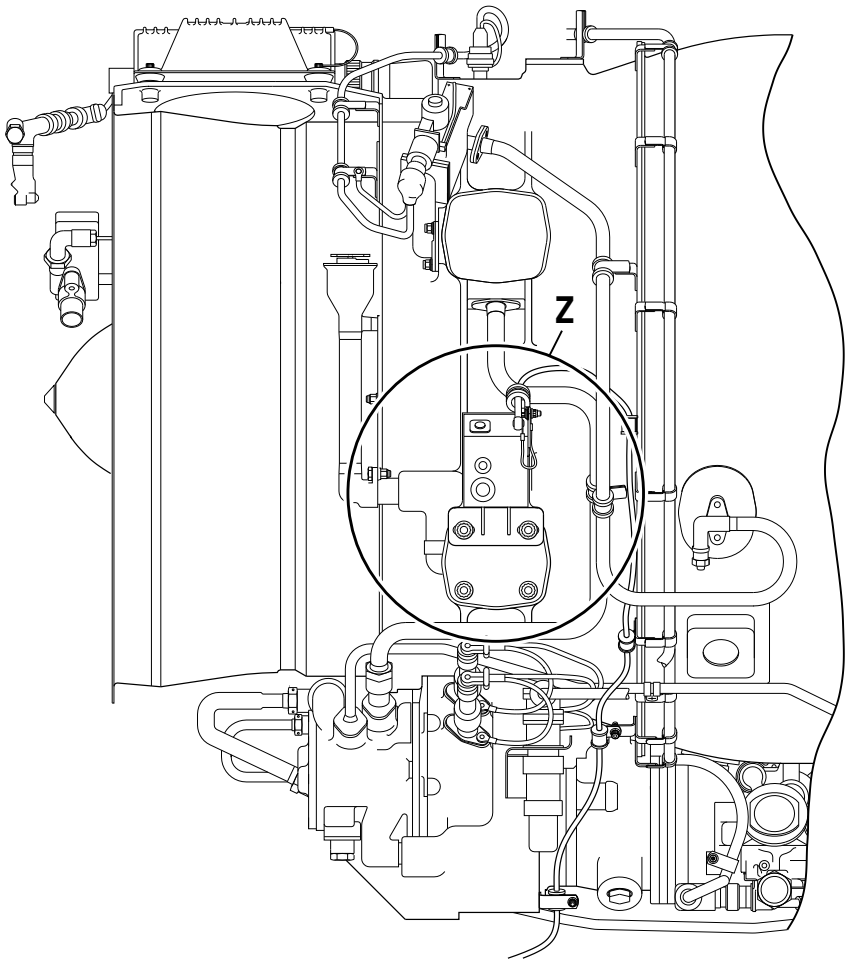


JT15D-5 Shown (JT15D-5R Similar) C97190

Removal/Installation - Remote Oil Level Indicator Panel
Figure 201 (Sheet 1 of 3)

Key to Figure 201

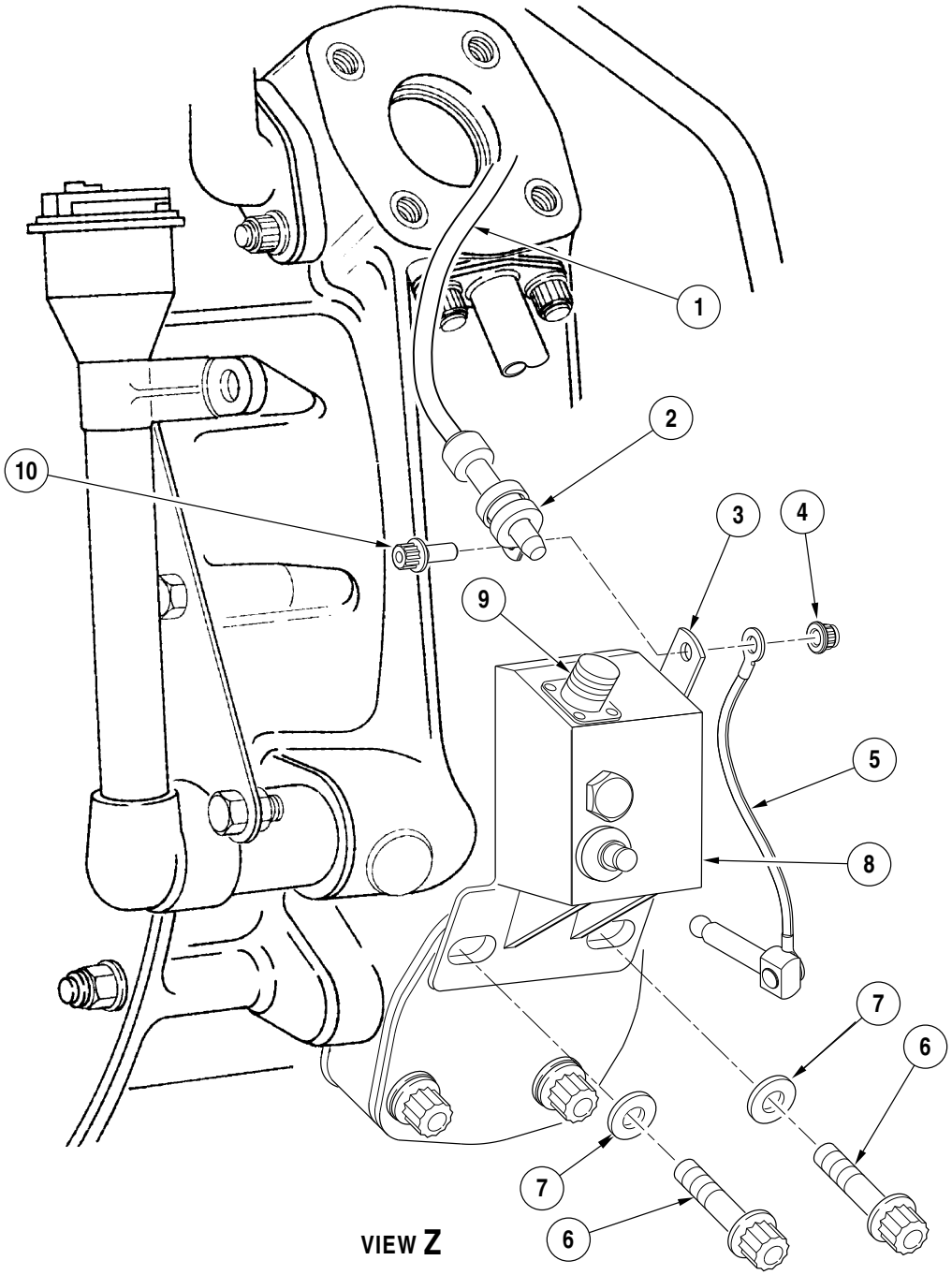
1. Chip Detector Cable
2. Loop Clamp Assembly
3. Bracket
4. Nut
5. Chip Detector Cable Plug
6. Bolt
7. Washer
8. Remote Oil Level Indicator Panel
9. Electrical Connector
10. Bolt



ENGINE INSTALLED ON THE RIGHT SIDE OF THE AIRCRAFT

C97191

Removal/Installation - Remote Oil Level Indicator Panel
Figure 201 (Sheet 2)



C97192

Removal/Installation - Remote Oil Level Indicator Panel
Figure 201 (Sheet 3)

CAUTION: TO PREVENT FRETTING DAMAGE TO THE INTERMEDIATE CASE OIL FILLER NECK BOSS, PUSH THE PANEL TO THE MAXIMUM REARWARD LOCATION ON THE MOUNT PAD.

(2) Push the panel (8) to the maximum rearward location on the mount pad to create a gap between the intermediate case and the panel. Secure indicator panel (8) to mount pad with two washers (7) and bolts (6) in this position. Tighten and torque bolts to 275 to 300 lb.in. and lockwire.

(3) Secure loop clamp (2) on chip detector cable (1) and plug (5) to bracket (3) with bolt (10) and nut (4). Tighten nut and torque to 36 to 40 lb.in.

(4) Connect the aircraft harness to the remote oil indicator panel electrical connector (9) (Ref. Aircraft Maintenance Manual).

6. Cleaning

A. Remote Oil Level Indicator Panel

(1) Wipe remote oil level indicator panel using a clean cloth and isopropyl alcohol (PWC11-014B).

(2) Clean each electrical connector using isopropyl alcohol as follows:

(a) Apply isopropyl alcohol (PWC11-014B) to electrical connector well.

(b) Clean electrical connector pins while alcohol is present using a suitable artist's paint brush.

NOTE: The tip of the brush's bristles may be cut off to allow better access to the pins.

(c) Drain isopropyl alcohol (PWC11-014B) and apply clean, oil-free compressed air to connector area to remove all traces of the alcohol.

(d) Inspect electrical connector pins using a 16- power magnifying glass for dirt. Repeat cleaning if required.

(e) Put a protective cap on the electrical connector if panel has been removed.

7. Inspection/Check

A. Remote Oil Level Indicator Panel - Visual Checks

(1) Check general condition of panel.

(2) Check pins on electrical connectors for damage using a 16X magnifying glass.

(3) Check bolting flanges for cracks, raised metal or burrs and other damage.

(4) Visually check general condition of button and indicator.

B. Remote Oil Level Indicator Panel - Functional Checks

(1) Perform functional checks on remote oil level indicator panel (2) in accordance with P&WC Component Maintenance Manual (CMM) 79-31-10, P&WC publication P/N 3070188, or send panel (2) to the following address for functional checks:

P&WC Accessories and Component Repair Business
2525 Fernand Lafontaine
Longeuil, Quebec
Canada J4G 1A1

Attention: JT15D Operations

8. Repair

A. Remote Oil level Indicator Panel

(1) Repair or refurbish the remote oil level indicator panel in accordance with P&WC Component Maintenance Manual (CMM) 79-31-10, P&WC publication P/N 3070188, or send panel to:

Norwich Aero Products
50 O'Hare Drive
Norwich, NY 13815
USA

Attention: REPAIRS
TEL: (607) 336-7636

R/O/L INDICATOR AND HOUSING - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the JT15D-5 (Post-SB7596) and JT15D-5R remote oil indicator and housing.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC11-014	Alcohol, Isopropy

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal of Remote Oil Indicator and Housing (Ref. Fig. 201)

   CAUTION: CAP ALL OPENINGS TO PREVENT ENTRY OF FOREIGN MATERIAL.

   (1) Disconnect the aircraft electrical connector from the mating electrical connector on the indicator (2)(Ref. Aircraft Maintenance Manual).

   (2) Drain oil tank from oil tank until it is below level of connection with intermediate case (Ref. 72-00-00, SERVICING).

   (3) Disconnect lower vent tube (13) and coupling (12) from connector on the remote oil indicator housing (5).

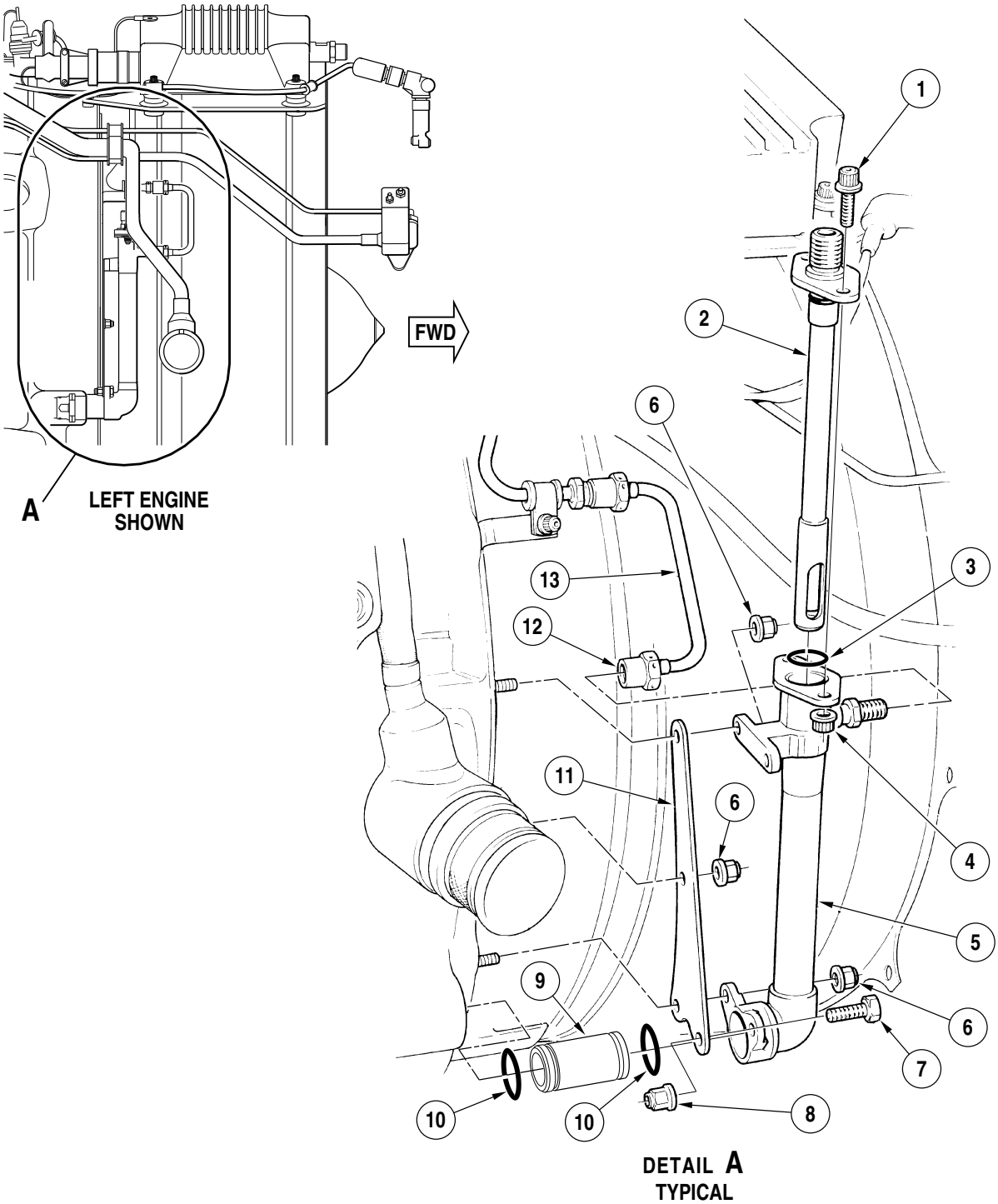
   (4) Remove self-locking nut (8) and bolt (7) securing outboard flange of indicator housing (6) to indicator plate (11).

   (5) Remove two self-locking nuts (6) at inboard flanges of indicator housing (6) and withdraw indicator housing (5) and transfer tube (9) from intermediate case boss.

   (6) Withdraw transfer tube (9) from indicator housing (6), and remove and discard two preformed packings (10) from each end of transfer tube.

   (7) Remove two bolts (1) and self-locking nuts (4) securing oil level indicator (2) to indicator housing (5). Withdraw oil level indicator from housing. Remove and discard preformed packing (3) from oil level indicator.

   (8) Put a protective cap on exposed indicator electrical connector.

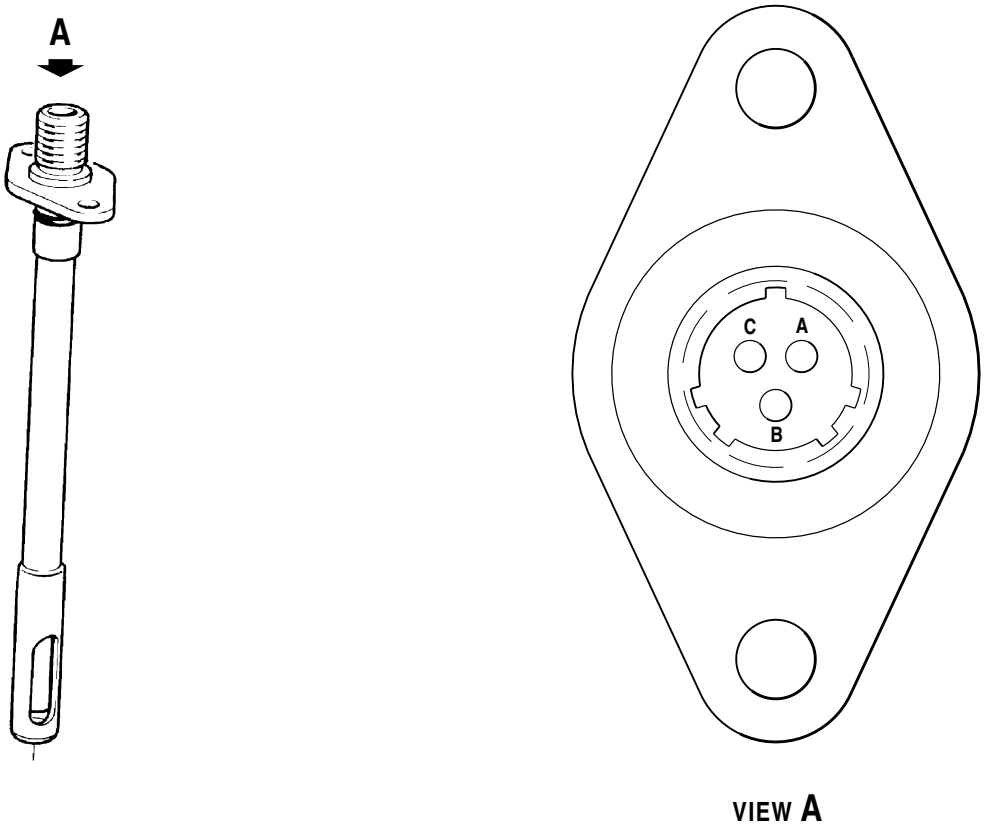


JT15D-5 Shown (JT15D-5R Similar) C97193

Removal/Installation - Remote Oil Indicator and Housing
Figure 201 (Sheet 1 of 2)

Key to Figure 201

1. Bolt
2. Oil Level Indicator
3. Preformed Packing
4. Self-locking Nut
5. Oil Indicator Housing
6. Self-locking Nut
7. Bolt
8. Self-locking Nut
9. Transfer Tube
10. Preformed Packing
11. Remote Oil Indicator Mounting Plate
12. Coupling Nut
13. Lower Vent Tube



C78256

Removal/Installation - Remote Oil Indicator and Housing
Figure 201 (Sheet 2)

(9) If required, remove remaining flange nut nut (6) and the mounting plate (11).

B. Installation of Remote Oil Indicator and Housing (Ref. Fig. 201)

NOTE: The remote oil indicator is mounted on the inboard side of the engine. For left-hand engines, the remote oil indicator is mounted on the right-hand side of the engine. For right hand engines, the remote oil indicator is mounted on the left-hand side of the engine.

(1) If required, install the remote oil indicator mounting plate (11) on the right or left side of the engine with center bolt hole over stud at the 3 o'clock or 9 o'clock location. Install nut (6) to secure the plate. Tighten and torque the nut to 75 to 85 lb.in.

(2) Install two new preformed packings (10) on transfer tube (9) and install transfer tube into boss on oil indicator housing (5).

(3) Install housing (5) with transfer tube (9) in boss at intermediate case. Ensure transfer tube does not contact mounting plate (11). Ensure flanges of housing engage studs on intermediate case Flange A.

(4) Secure housing (5) to intermediate case Flange A with two self-locking nuts (6). Tighten and torque self-locking nuts 75 to 85 lb.in.

(5) Secure housing (5) outer lower flange to mounting plate (11) with bolt (7) and self-locking nut (8). Tighten and torque self-locking nut 85 to 95 lb.in.

(6) Install preformed packing (3) on oil level indicator (2) and insert indicator into indicator housing (5). Secure flanges of level indicator (2) to housing (5) with two bolts (1) and self-locking nuts (4). Tighten and torque nuts 36 to 40 lb.in.

(7) Secure the vent tube (13) to the mating connector on the housing (5)(Ref. 79-30-04, MAINTENANCE PRACTICES).

(8) Connect the aircraft electrical connector to the mating electrical connector on the indicator (2)(Ref. Aircraft Maintenance Manual).

(9) Replenish engine oil tank (Ref. 72-00-00, SERVICING).

6. Cleaning

A. Remote Oil Level Indicator

(1) Wipe the remote oil level indicator externally using a clean cloth and isopropyl alcohol (PWC11-014B).

(2) Clean electrical connector using isopropyl alcohol as follows:

(a) Apply isopropyl alcohol (PWC11-014B) to electrical connector well.

(b) Clean electrical connector pins while alcohol is present using a suitable artist's paint brush.

NOTE: The tip of the brush's bristles may be cut off to allow better access to the pins.

(c) Drain isopropyl alcohol (PWC11-014B) and apply clean, oil-free compressed air to connector area to remove all traces of the alcohol.

(d) Inspect electrical connector pins using a 16-power magnifying glass for dirt. Repeat cleaning if required.

(e) Put a protective cap on the electrical connector.

7. Inspection/Check

A. Remote Oil Level Indicator - Visual Checks

(1) Check remote oil level indicator (2) for loose or bent electrical connector pins.

(2) Check for cracks on probe and on float.

(3) Check for damaged electrical connector threads.

(4) Use a suitable stone to blend out nicks, scoring, burrs or raised metal.

(5) Check general condition of oil level indicator.

B. Remote Oil Level Indicator - Electrical Checks

(1) Check insulation resistance of remote oil level indicator (2) at 500 V dc as follows using a suitable test set:

(a) Check Pins A and B to remote oil level indicator shell for minimum 40 Meg. Ω resistance.

(b) Check Pins A and B to Pin C for minimum 40 Meg. Ω. resistance.

(c) Check Pin C to remote oil level indicator shell for minimum 40 Meg. Ω resistance.

(d) Reject remote oil level indicator if it fails any electrical check.

C. Remote Oil Level Indicator - Operational and Leakage Checks

(1) Perform operational and leakage checks on remote oil level indicator in accordance with P&WC Component Maintenance Manual (CMM) 79-31-08, P&WC publication P/N 3058470, or send remote oil indicator to the following address (specify operational and leakage checks):

P&WC Accessories and Component Repair Business
2525 Fernand Lafontaine
Longeuil, Quebec
Canada J4G 1A1

Attention: JT15D Operations

8. Repair

A. Remote Oil Level Indicator

(1) The remote oil level indicator cannot be disassembled: repair indicator by replacement.

R/O/L INDICATOR VENT TUBES - MAINTENANCE PRACTICES

1. General

   A. The following are the maintenance practices for the JT15D-5 (Post-SB7596) and JT15D-5R remote oil level indicator vent tubes.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC03-001	Oil, Engine Lubricating
PWC05-061	Cloth, Coated Abrasive
PWC11-021	Compound, Chromate Conversion
PWC11-027	Solvent, Petroleum

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   Not Applicable

5. Removal/Installation

   A. Removal of Remote Oil Level Indicator Vent Tubes (Ref. Fig. 201)

      NOTE: Threaded cap (9) is normally not removed from the main vent tube (7) unless the engine is being relocated to the opposite side of the aircraft (Ref. Subpara. C.).

      (1) Remove lockwire and disconnect coupling nut on lower vent tube (20) from connector on remote oil level indicator housing (View B).

      (2) Loosen and remove bolt (5) and nut (3) from bracket (21) (View B).

      (3) Remove lockwire and disconnect coupling nut on upper vent tube (1) from mid-point connector on main vent tube (7).

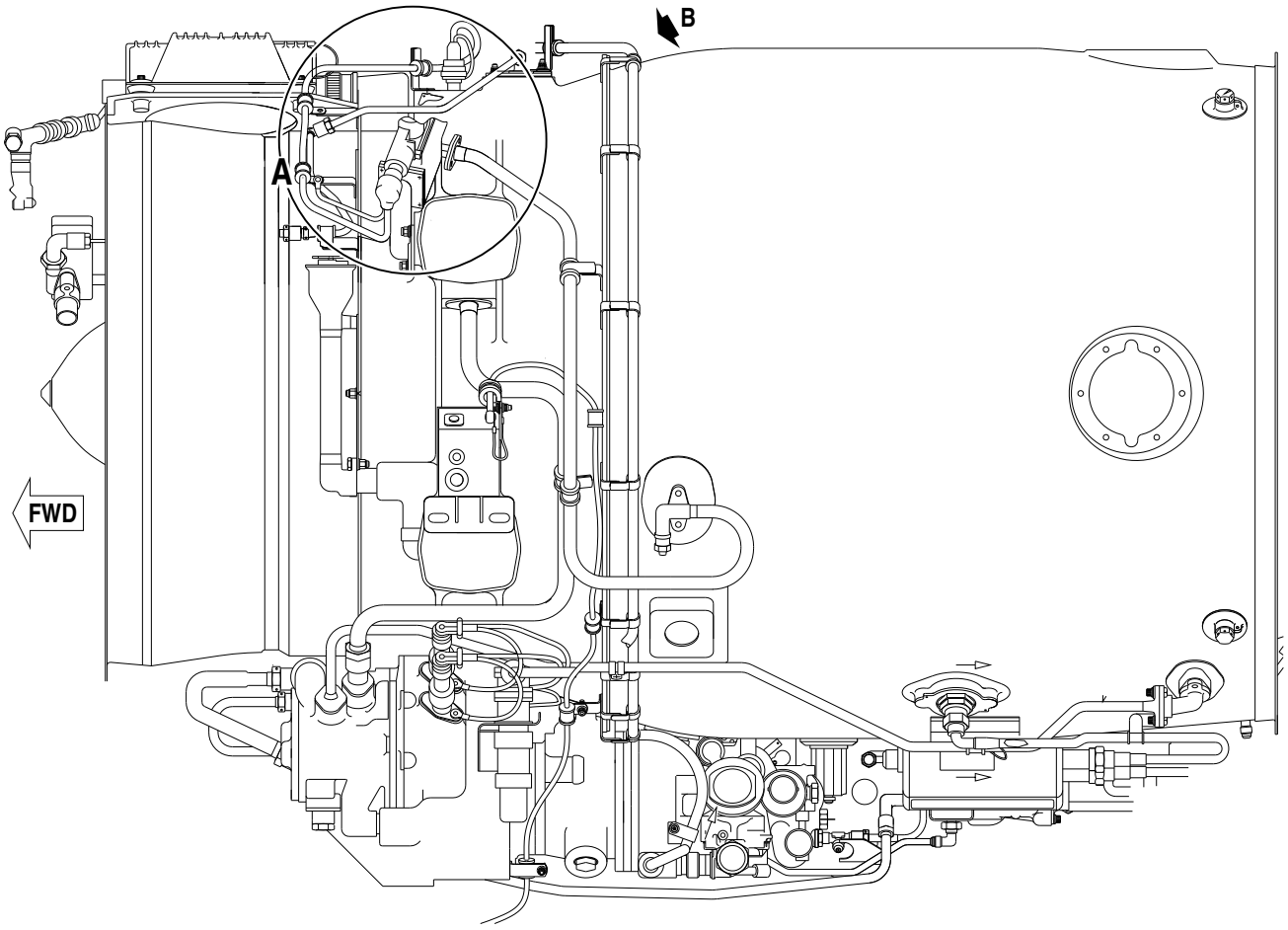
      (4) For JT15D-5R engines, remove the nut (18) and bolt (17) that attach the loop clamps (12), (14), and if applicable (15), to the bracket (11).

      (5) Remove lockwire and disconnect upper vent tube coupling nut from elbow (2), then remove the tube.

      (6) Loosen and remove two bolts (5) and nuts (3) from brackets (4) and (10).

      (7) Remove main vent tube assembly (7). Remove loop clamps (6) and (8) from tube.

      (8) If required, remove and retain all serviceable loop clamps (6), (8) and (19).



**JT15D–5 (POST–SB7596/ POST–SB7597/ POST–SB7599) SHOWN
(JT15D–5R SIMILAR)**

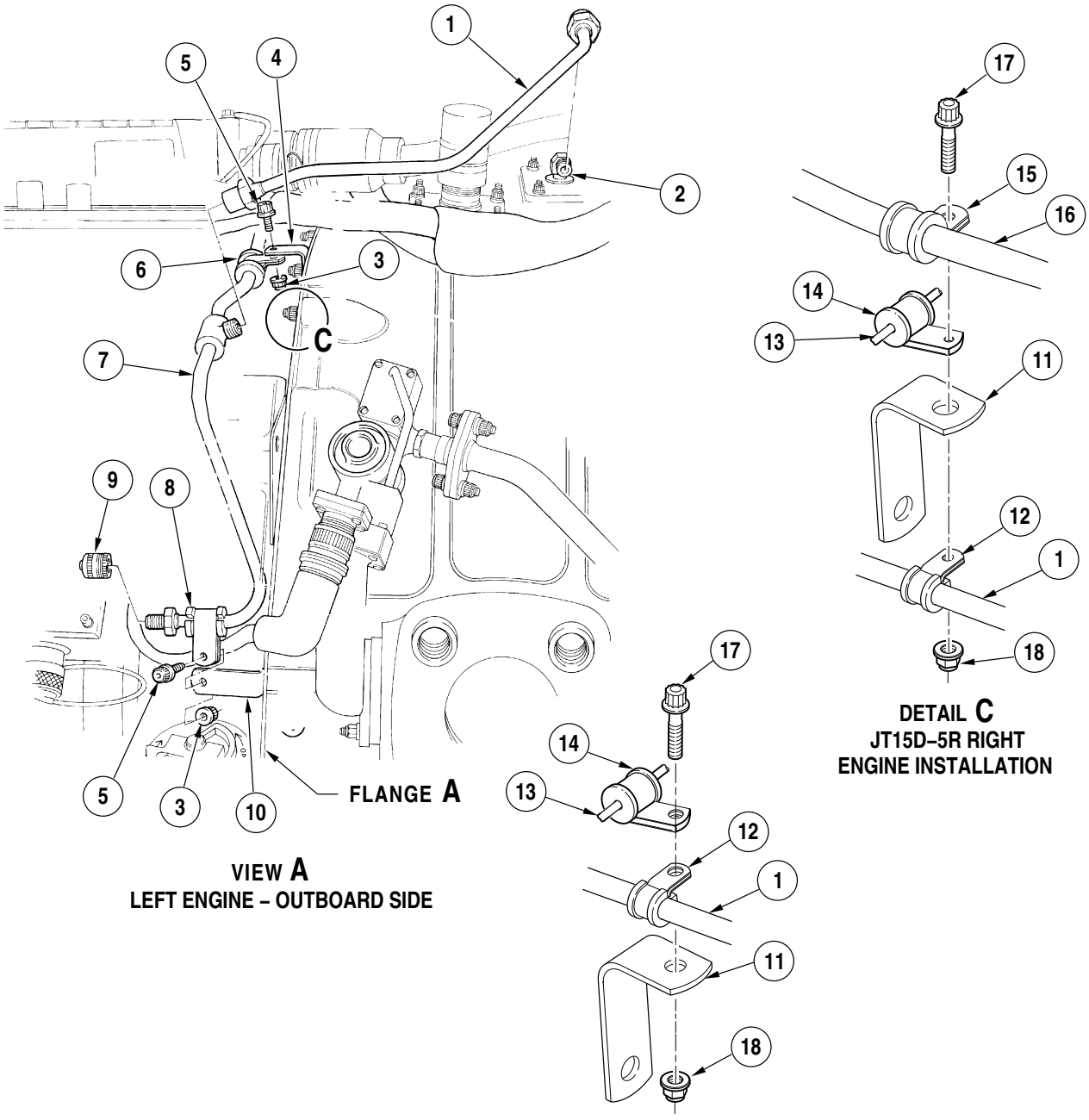
LEFT ENGINE SHOWN – OUTBOARD SIDE

C97302A

Removal/Installation - Remote Oil Level Indicator Vent Tube Assembly
Figure 201 (Sheet 1 of 3)

Key to Figure 201

1. Upper Vent Tube Assembly
2. Elbow Connector
3. Self-locking Nut
4. Flange A Angle Bracket
5. Bolt
6. Loop Clamp Assembly
7. Main Vent Tube Assembly
8. Loop Clamp Assembly
9. Cap
10. Flange A Angle Bracket
11. Flange A Angle Bracket
12. Loop Clamp
13. Wiring Harness
14. Loop Clamp
15. Loop Clamp
16. Main Wiring Harness
17. Bolt
18. Self-locking Nut
19. Loop Clamp
20. Lower Vent Tube
21. Flange A Angle Bracket



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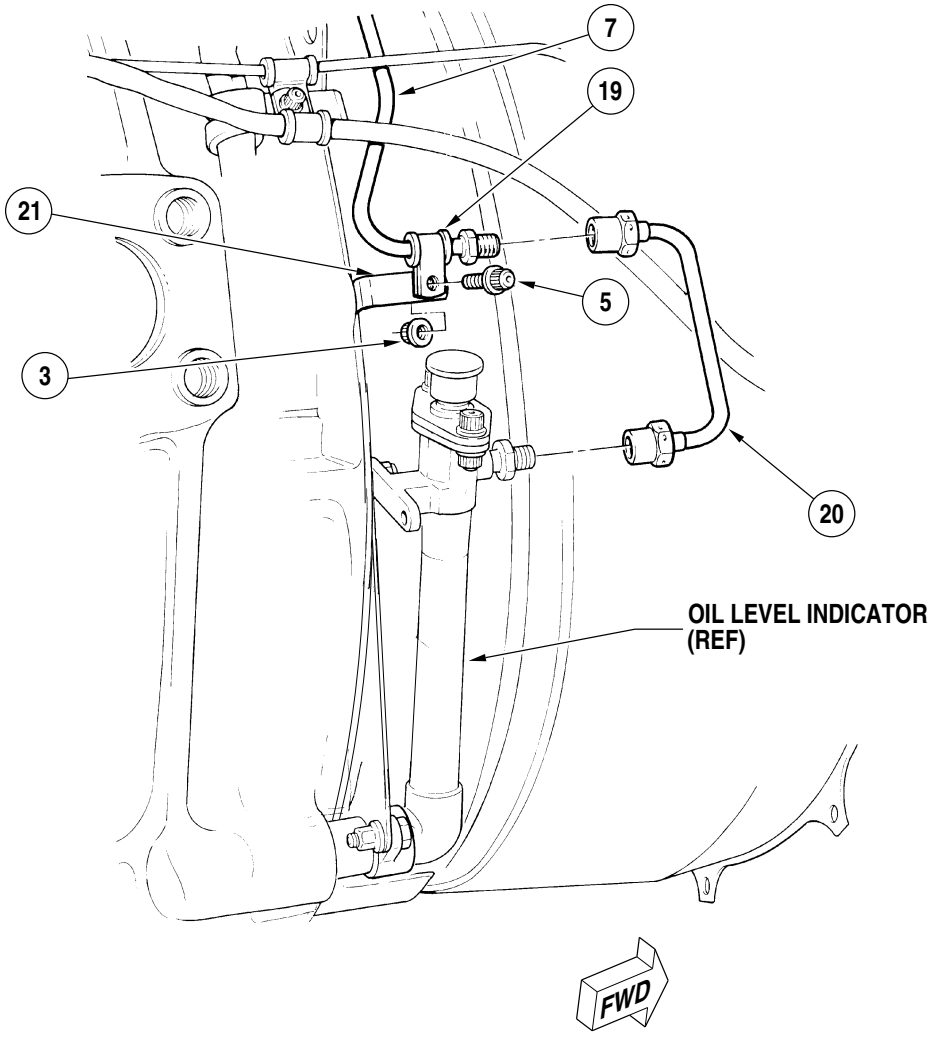
Removal/Installation - Remote Oil Level Indicator Vent Tube Assembly
Figure 201 (Sheet 2)



VIEW B

LEFT ENGINE – INBOARD SIDE

C97195A

Removal/Installation - Remote Oil Level Indicator Vent Tube Assembly
Figure 201 (Sheet 3)

B. Installation of Remote Oil Level Indicator Vent Tubes (Ref. Fig. 201)

(1) Install three loop clamp assemblies (6), (8) and (19) on the main vent tube assembly (7).

(2) Put the main vent tube assembly (7) in position on the engine on forward side of Flange A.

(3) Secure coupling nuts on the lower vent tube (20) to mating connectors on main vent tube (7) and on the remote oil level indicator. Tighten the coupling nuts finger-tight.

(4) Secure coupling nuts on the upper vent tube (1) to mating connector at the center of main vent tube (7) and to the elbow (2). Tighten the tube coupling nuts finger-tight.

(5) For JT15D-5R engines, attach the upper vent tube (1), wiring harness (13), main wiring harness (if applicable) (16), and clamps (12), (14), and (15) to the bracket (11) with the bolt (17) and nut (18). Torque the nut 36 to 40 lb.in.

(6) Secure loop clamp assembly (8) on tube (7) to angle bracket (10) with bolt (5) and nut (3) (View A). Tighten and torque nut to 36 to 40 lb.in.

(7) Secure loop clamp assembly (19) to angle bracket (21) with bolt (5) and nut (3) (View B). Tighten and torque nut to 36 to 40 lb.in.

(8) Secure loop clamp assembly (6) to bracket (4) with bolt (5) and nut (3). Tighten and torque nut to 36 to 40 lb.in.

(9) Hold upper vent tube (1) then torque both tube coupling nuts to 90 to 100 lb.in. Secure both coupling nuts with with lockwire.

(10) Hold lower vent tube (20) then torque both tube coupling nuts to 90 to 100 lb.in. Secure both coupling nuts with with lockwire.

C. Relocation of Vent Tubes for Converting the Engine for Installation on Opposite Side of the Aircraft

NOTE: The following procedure applies when an engine is re-positioned to the opposite side of the aircraft.

(1) Remove lockwire, then disconnect and remove the U-shaped lower vent tube (12).

(2) Remove lockwire and cap (9) from right or left-hand side of main vent tube assembly (7).

(3) Remove the remote oil indicator and housing assemblies and mounting plate (Ref. 79-30-03). Remove the oil filler neck and mounting plate (Ref. 79-30-01). Install these items on opposite sides of engine.

(4) Install lower vent tube (12) between connectors on tube (7) and relocated remote oil indicator housing. Torque tube coupling nuts to 90 to 100 lb.in. and secure with lockwire.

(5) Install cap (9) on exposed end of main vent tube assembly (7). Torque cap to 90 to 100 lb.in. and lockwire.

6. Cleaning/Painting

A. Remote Oil Indicator Vent Tubes

(1) Clean tubing as follows:

(a) Soak external oil tubing in cold carbon remover (PWC11-021) for two hours at room temperature.

(b) Rinse tube exterior with petroleum solvent (PWC11-027).

(c) Pressure flush tube interior with petroleum solvent and dry interior and exterior with compressed air.

7. Inspection/Check

A. Remote Oil Indicator Vent Tubes

(1) Inspect tube visually for damage as follows:

(a) Cracks - Cracked tube must be replaced. No repair is permitted.

(b) Scratches - Minor scratches having no appreciable depth are acceptable. Scratches to a depth of 0.005 inch must be blended out. Replace tube with scratches over 0.005 inch deep.

(c) Nicks - Individual nicks up to 0.062 inch long by 0.010 inch wide and 0.003 inch deep can be ignored. Nicks to a maximum depth of 0.005 inch must be blended out to remove sharp edges. Replace tubing with nicks greater than 0.005 inch deep.

(d) Dents - Round bottom dents on straight sections of tube are permitted provided the length and depth are not greater than 10 percent of the normal outside diameter of tube. No more than one dent to maximum depth per 12 inch length of tube is acceptable. Dents on tube bends, which cause restriction by flattening and local weakening, are not acceptable.

(e) Pitting - Minor isolated pitting up to 0.003 inch deep is acceptable. Clusters of pitting should be blended out to a maximum depth of 0.005 inch. Tubing must be replaced if pitting exceeds 0.005 inch deep.

(f) Corrosion - Staining on tube and surface corrosion is acceptable if removable by light polishing with crocus cloth (PWC05-061)and oil (PWC03-001).

CHIP DETECTION SYSTEM - MAINTENANCE PRACTICES

1. General

   A. A magnetic chip detection system is found on JT15D-5 BS1191 (Post-SB7599/Post-SB7600) and JT15D-5R BS1221 (Post-SB7608) engines. The following are the maintenance practices for the magnetic chip detection system.

2. Consumable Materials

   The consumable materials listed below are used in the following procedures.

Item No.	Name
PWC11-027	Petroleum Solvent

3. Special Tools

   Not Applicable

4. Fixtures, Equipment and Supplier Tools

   The following are the fixtures and equipment required for the magnetic chip detection system.

Name	Remarks
Test Set, Resistance and Continuity Checks	TT-1000A

5. Removal/Installation

   A. Removal of Magnetic Chip Detector (Ref. Fig. 201)

      (1) Disconnect the electrical connector on chip detector cable (4) from the magnetic chip detector (3).

      (2) Loosen and remove the chip detector (3) from the self-closing valve (1). Remove and discard two preformed packings (2).

      (3) Do not remove self-closing valve (1) unless required. If required: cut lockwire and remove valve from accessory gearbox (AGB). Collect drained oil in a clean container.

   B. Removal of Chip Detector Cable Assembly (Ref. Fig. 201)

      (1) Disconnect the electrical connector on chip detector cable (4) from the magnetic chip detector (3).

      (2) **For Engine Installed on the Left Side of the Aircraft:**

         (a) Refer to Sections H-H and M-M: loosen and remove three nuts (10) and bolts (8) securing loop clamps (9) to loop clamp (12) and to two angle brackets (11) on the AGB (Section F-F).

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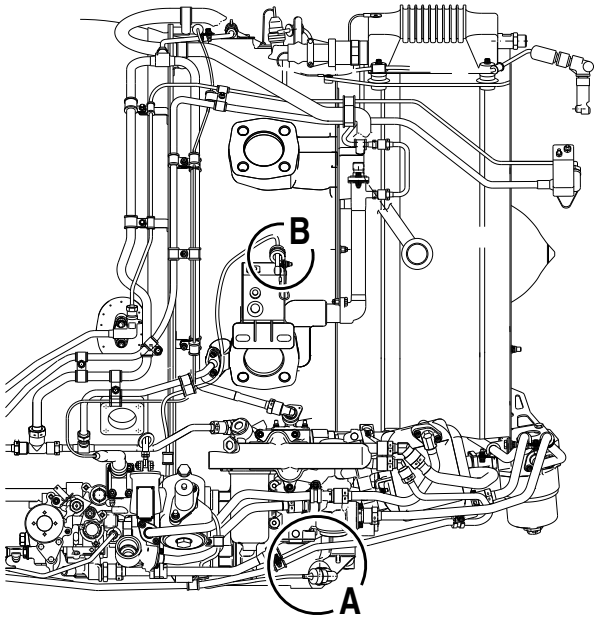
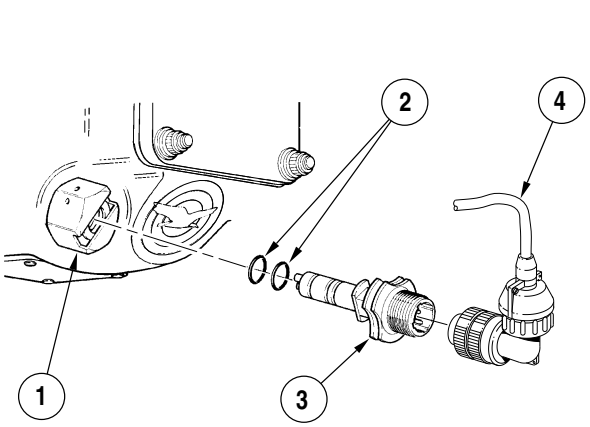
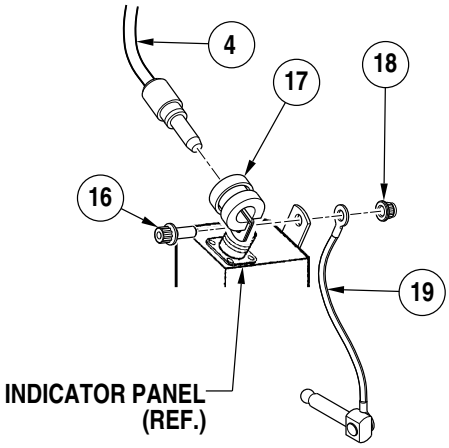




DETAIL A



DETAIL B

RIGHT AND LEFT ENGINES

JT15D-5R SHOWN, JT15D-5 SIMILAR C112805

Removal/Installation - Magnetic Chip Detector Assembly
Figure 201 (Sheet 1 of 6)

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Key to Figure 201

1. Chip Detector Self-closing Valve
2. Preformed Packing
3. Magnetic Chip Detector
4. Chip Detector Cable
5. Preformed Packing
6. Self-locking Nut
7. Loop Clamp Assembly
8. Bolt
9. Loop Clamp Assembly
10. Self-locking Nut
11. Angle Bracket
12. Loop Clamp Assembly
13. Loop Clamp Assembly
14. Angle Bracket
15. Loop Clamp Assembly
16. Bolt
17. Loop Clamp Assembly
18. Self-locking Nut
19. Chip Detector Cable Plug Assembly

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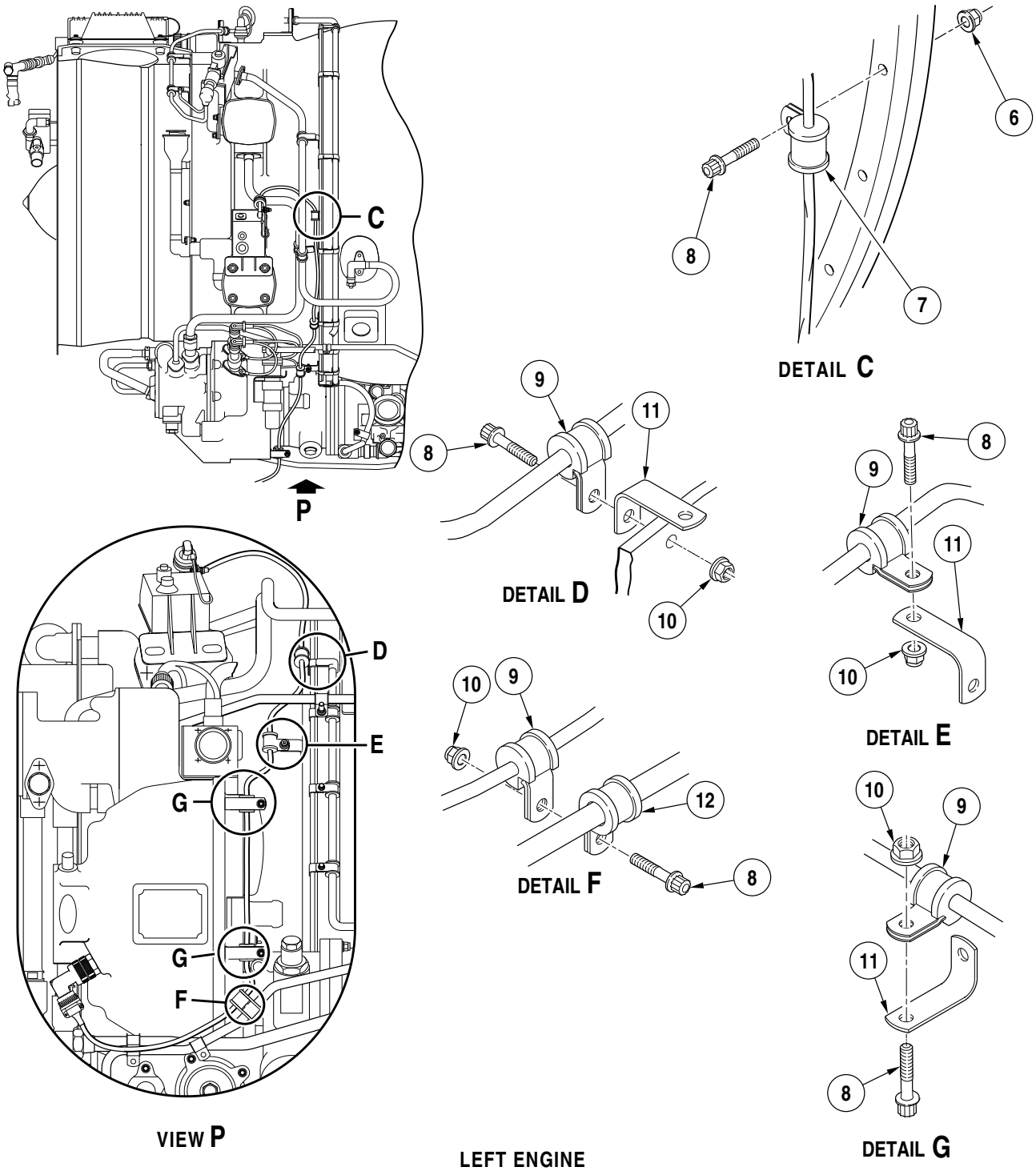

JT15D-5R SHOWN, JT15D-5 SIMILAR

C112806

Removal/Installation - Magnetic Chip Detector Assembly
Figure 201 (Sheet 2)

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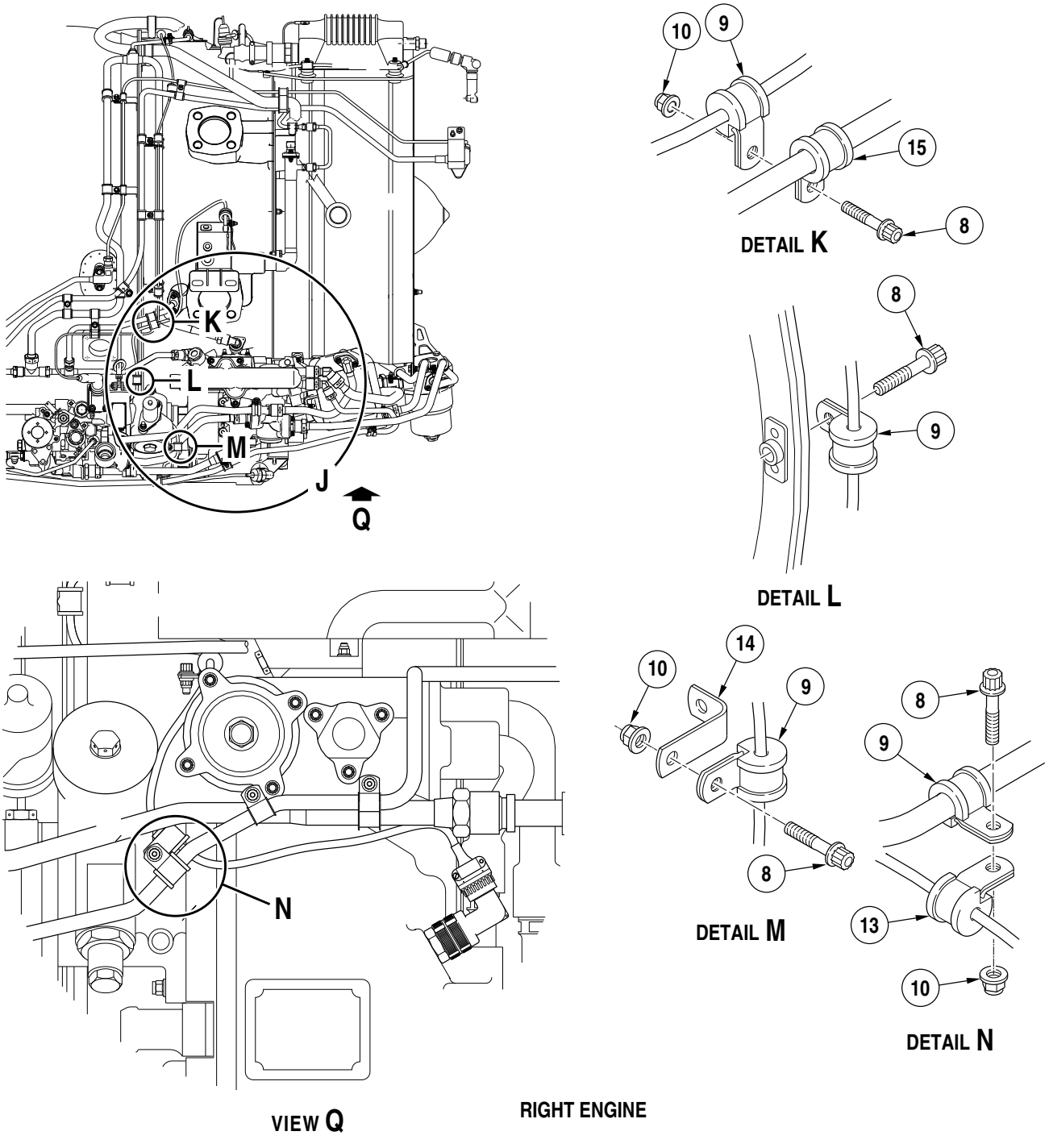

JT15D-5R SHOWN, JT15D-5 SIMILAR C112807

Removal/Installation - Magnetic Chip Detector Assembly
Figure 201 (Sheet 3)

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Removal/Installation - Magnetic Chip Detector Assembly
Figure 201 (Sheet 4)

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Removal/Installation - Magnetic Chip Detector Assembly
Figure 201 (Sheet 5)

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Removal/Installation - Magnetic Chip Detector Assembly
Figure 201 (Sheet 6)

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(b) Refer to Sections J-J and K-K: remove two nuts (10) and two bolts (8) securing cable (4) to Flange B angle brackets (11).

(c) Refer to Detail P: remove one nut (6) and bolt (8) securing loop clamp (7) to Flange B.

(d) Refer to View Z: remove bolt (16) and nut (18) securing cable (4), loop clamp (17) and plug assembly (19) to bracket on remote oil level indicator panel.

(3) **For Engine Installed on the Right Side of the Aircraft:**

(a) Refer to View C and to View G-G: loosen and remove bolt (8) and nut (10) securing loop clamp (9) to loop clamp (13).

(b) Refer to Section F-F: loosen and remove bolt (8) and nut (10) securing loop clamp (9) to Flange B angle bracket (14).

(c) Refer to Sections E-E and D-D: loosen and remove bolts (8) and nuts (10) securing loop clamps (9) to Flange B and to loop clamp (15).

(d) Refer to View Z: remove bolt (16) and nut (18) securing cable (4), loop clamp (17) and plug assembly (19) to bracket on remote oil level indicator panel.

C. Installation of Magnetic Chip Detector (Ref. Fig. 201)

(1) Lubricate two new preformed packings (2) with engine oil and install on magnetic chip detector (3).

(2) Install the magnetic chip detector (3) in the self closing valve (1).

NOTE: Ensure the magnetic chip detector is in the fully locked position. This position can be verified by feel while turning the magnetic chip detector clockwise.

(3) Connect and tighten the electrical connector chip detector cable (4) to mating connector on the chip detector (3).

D. Installation of Chip Detector Cable Assembly (Ref. Fig. 201)

(1) Connect and secure the connector on the chip detector cable (4) to mating connector on the magnetic chip detector (3) (Detail B). Make sure the master key on cable assembly is correctly aligned.

NOTE: If a replacement cable is to be installed, the chip detector electrical connector may require to have its backshell repositioned in order to permit clearance with the engine nacelle when the aircraft lower cowl is closed. To reposition the connector backshell proceed as follows:

(a) Loosen the backshell outer ring, then rotate the backshell assembly to reposition it to create the largest possible clearance between the lower cowl skin and the chip detector connector.

(b) Tighten the backshell outer ring and torque 65 to 75 lb.in.

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(2) **For Engine Installed on the Left Side of the Aircraft:**

(a) Refer to View L and to Section H-H: secure loop clamp (9) on chip detector cable (4) to loop clamp (12) on fuel pressure tube with nut (10) and bolt (8). Tighten the nut fingertight.

(b) Refer to Sections M-M: install two loop clamps (9) on the chip detector cable (4). Secure the loop clamps to two angle brackets (11) on the AGB cover flange using bolts (8) and nuts (10). Tighten the nuts fingertight.

(c) Refer to Section J-J: secure loop clamp (9) to Flange B angle bracket (11) using bolt (8) and nut (10). Tighten the nut fingertight.

(d) Refer to Section K-K: secure loop clamp (9) on chip detector cable (4) to back of Flange B angle bracket (11) with bolt (8) and self-locking nut (10). Tighten the nut fingertight.

(e) Refer to Detail P: secure loop clamp (7) on chip detector cable (4) to Flange B bolt hole with bolt (8) and nut (6). Tighten the nut fingertight.

(f) Secure the chip detector cable (4) to the remote oil level indicator panel (View Z):

1 Install loop clamp (17) on connector of chip detector cable assembly (4).

2 Secure loop clamp (17), connector and lanyard of the chip detector cable plug assembly (19) to bracket on indicator panel housing with bolt (16) and nut (17). Tighten and torque nut to 36 to 40 lb.in.

(g) Insert end of plug (19) into the female connector of the chip detector cable assembly (4).

(h) Apply final torque of 36 to 40 lb.in. to all nuts (10, 6) securing loop clamps after the cable has been correctly positioned.

(3) **For Engine Installed on the Right Side of the Aircraft:**

(a) Refer to View G-G: secure loop clamp (9) on chip detector cable (4) to loop clamp (13) on fuel pressure tube with nut (10) and bolt (8). Tighten the nut fingertight.

(b) Refer to Section F-F: secure loop clamp (9) to bracket (14) using bolt (8) and nut (10). Tighten the nut fingertight.

(c) Refer to Section E-E: secure loop clamp (9) on the chip detector cable (4) to Flange B with bolt (8) and nut (10). Tighten and torque the Flange B nut to 36 to 40 lb.in.

(d) Refer to Section D-D: secure loop clamp (9) on chip detector cable (4) to loop clamp (15) on fuel pressure tube with nut (10) and bolt (8). Tighten the nut fingertight.

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(e) Secure the chip detector cable (4) to the remote oil level indicator panel (View Z):

1 Install loop clamp (17) on connector of chip detector cable assembly (4).

2 Secure loop clamp (17), connector and lanyard of the chip detector cable plug assembly (19) to bracket on indicator panel housing with bolt (16) and nut (17). Tighten and torque the nut to 36 to 40 lb.in.

(f) Insert end of plug (19) into the female connector of the chip detector cable assembly (4).

(g) Apply final torque of 36 to 40 lb.in. to all nuts (10) securing loop clamps after the cable has been correctly positioned.

E. Installation of Self-closing Valve (Ref. Fig. 201)

(1) Install new preformed packing (5) on self-closing valve (1). Install valve in AGB drain boss. Torque valve 175 to 225 lb.in. Lockwire valve to AGB.

(2) Service engine oil system if self-closing valve was installed (Ref. 72-00-00, OIL SYSTEM - SERVICING).

(3) Check the AGB for leaks at the AGB drain boss.

6. Inspection/Check

A. Inspection of Magnetic Chip Detector

(1) Inspect magnetic pole for presence of foreign material. If found, proceed as follows:

(a) Dip magnet in solvent (PWC11-027) to remove oil. Transfer debris from magnet to clear adhesive tape. Identify tape with engine serial number, hours run since new and location of chip detector.

(b) Determine size and composition of foreign material before further engine operation (Ref. 79-20-01, MAINTENANCE PRACTICES, Inspection/Check).

(c) Inspect oil filter element (Ref. 79-20-01, MAINTENANCE PRACTICES, Inspection/Check).

(2) Allowable Debris:

(a) Small amount of hair-like filaments (fuzz).

(b) Small amount of powder.

(c) Spiral curls (machining swarf).

(d) Silver plating.

(3) Unacceptable Debris:

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(a) Large quantity of fuzz and/or powder filaments that completely cover the chip detector magnetic pole.

(b) Dark, irregular magnetic chips (0.010 in. min. dimension).

(c) Small clusters of three or more magnetic flakes; see NOTE below:

NOTE: Thin, shiny rolled flakes with feathered edges and more than 0.020 in. (0.058 mm) in size are generated when bearing surfaces break down due to excessive load (spalling). The outer surface of these flakes are highly polished and may show parallel impressions. The inner surface has a rough wavy or granular texture. After the bearing surface breaks down , the underlying material disintegrates and chips having dark, coarse and irregular shapes are produced.

(d) Identifiable fragments such as keywasher keys or gear tooth segments (Ref. 79-20-01, MAINTENANCE PRACTICES, Inspection/Check).

(4) DELETED.

B. Inspection of Chip Detector Cable Assembly

(1) Inspect general condition of cable assembly.

C. Inspection of Self-closing Valve

(1) Remove chip detector and check valve for leaks at AGB boss. Reject valve if there is internal leakage.

(2) If oil leaks at port in AGB, remove valve, replace preformed packing and reinstall.

7. Adjustment/Test

A. Magnetic Chip Detector

(1) Chip detector must be capable of lifting an 8 oz. weight.

(2) Check continuity between each connector pin and body of chip detector using a suitable test set. An open circuit must be indicated. Reject chip detector indicating a closed circuit.

(3) Bridge magnetic poles with a suitable metallic jumper and check continuity across connector pins using ohmeter. A closed circuit must be indicated. Reject chip detector indicating an open circuit.

B. Chip Detector Cable Assembly

(1) Check continuity between terminals on threaded connector using a suitable test set. An open circuit must be indicated. Reject cable indicating a closed circuit.

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